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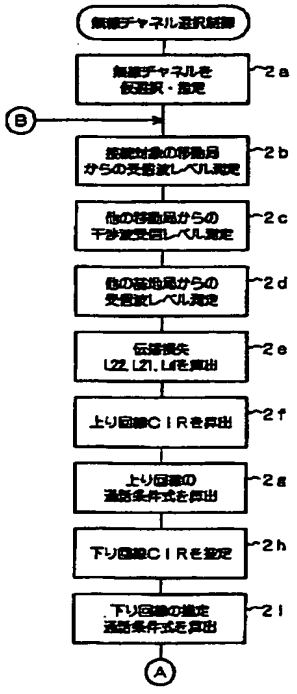
(54)【発明の名称】　移動通信システムの無線チャネル選択方法および基地局装置

(57)【要約】

【目的】　無線チャネルを割り当てる際に、制御チャネルにおける通信量の増加や接続遅延の発生を生じずに、しかも収容可能呼量を多く確保して周波数利用効率を高める。

【構成】　接続対象の移動局ＰＳ２から到来した搬送波の受信レベルと、同一の無線チャネルを介して他の移動局ＰＳ１から到来した干渉波の受信レベルとから上り回線のＣＩＲ値を求めるとともに、他の基地局ＢＳ１から到来した搬送波の受信レベルを基に下り回線のＣＩＲ値を推定して求め、これらの上り回線のＣＩＲ測定値および下り回線のＣＩＲ推定値を基に無線チャネルの使用可否を判定するようにしたものである。



【特許請求の範囲】
【請求項１】　複数の基地局と、複数の移動局とを有する移動通信システムにあって、前記各基地局と各移動局との間を複数の無線チャネルの中から適当な無線チャネルを選択して接続する無線チャネル選択方法において、
前記各基地局および各移動局のうちの接続対象の基地局と移動局との間を接続するための無線チャネルを選択する際に、
前記複数の無線チャネルのうちの任意の無線チャネルを介して前記接続対象の移動局から到来した搬送波の受信レベルと、前記任意の無線チャネルと同一の無線チャネルを介して他の移動局および他の基地局からそれぞれ到来した搬送波の受信レベルとを前記接続対象の基地局でそれぞれ測定する工程と、
測定された前記接続対象の移動局から到来した搬送波の受信レベルと前記他の移動局から到来した搬送波の受信レベルとに基づいて、前記接続対象の移動局から接続対象の基地局に向かう上り回線の受信波対干渉波比を求める工程と、
測定された前記接続対象の移動局から到来した搬送波の受信レベルと前記他の基地局から到来した搬送波の受信レベルとに基づいて、前記接続対象の基地局から前記接続対象の移動局へ向かう下り回線の受信波対干渉波比を推定する工程と、
前記上り回線の受信波対干渉波比および下り回線の推定受信波対干渉波比に基づいて前記任意の無線チャネルの使用の可否を判定する工程とを備えたことを特徴とする移動通信システムの無線チャネル選択方法。
【請求項２】　複数の基地局装置と、複数の移動局とを有し、これらの各基地局装置と各移動局との間を複数の無線チャネルの中から適当な無線チャネルを選択して接続する移動通信システムにおいて使用される前記基地局装置において、
前記複数の無線チャネルのうちの任意の無線チャネルを介して前記接続対象の移動局から到来した搬送波の受信レベルと、前記任意の無線チャネルと同一の無線チャネルを介して他の移動局および他の基地局装置からそれぞれ到来した搬送波の受信レベルとをそれぞれ測定するための受信レベル測定手段と、
この受信レベル測定手段により測定された前記接続対象の移動局から到来した搬送波の受信レベルと前記他の移動局から到来した搬送波の受信レベルとに基づいて、前記接続対象の移動局から自己の基地局装置に向かう上り回線の受信波対干渉波比を求めるための第１の干渉検出手段と、
前記受信レベル測定手段により測定された前記接続対象の移動局から到来した搬送波の受信レベルと前記他の基地局装置から到来した搬送波の受信レベルとに基づいて、自己の基地局装置から前記接続対象の移動局へ向かう下り回線の受信波対干渉波比を推定するための第２の干渉検出手段と、
前記第１および第２の干渉検出手段により得られた上り回線の受信波対干渉波比および下り回線の推定受信波対干渉波比に基づいて前記任意の無線チャネルの使用の可否を判定するための判定手段とを具備したことを特徴とする移動通信システムの基地局装置。
【請求項３】　複数の基地局装置の送信レベルおよび複数の移動局の送信レベルがそれぞれ同一値に設定されている場合に、
第１の干渉検出手段は、接続対象の移動局から到来した搬送波の受信レベルと前記移動局の送信レベルとから前記接続対象の移動局から自己の基地局装置へ向かう伝送路の伝播損失を求めるとともに、他の移動局から到来した搬送波の受信レベルと前記移動局の送信レベルとから前記他の移動局から自己の基地局装置へ向かう伝送路の伝播損失を求め、これらの伝播損失の差を基に前記接続対象の移動局から自己の基地局装置に向かう上り回線の受信波対干渉波比を求めることを特徴とする請求項２に記載の移動通信システムの基地局装置。
【請求項４】　複数の基地局装置の送信レベルおよび複数の移動局の送信レベルがそれぞれ同一値に設定されている場合に、
第２の干渉検出手段は、接続対象の移動局から到来した搬送波の受信レベルと前記移動局の送信レベルとから前記接続対象の移動局から自己の基地局装置へ向かう伝送路の伝播損失を求めるとともに、他の基地局装置から到来した搬送波の受信レベルと前記基地局装置の送信レベルとから前記他の基地局装置から自己の基地局装置へ向かう伝送路の伝播損失を求め、これらの伝播損失の差を基に自己の基地局装置から前記接続対象の移動局に向かう下り回線の受信波対干渉波比を推定することを特徴とする請求項２に記載の移動通信システムの基地局装置。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、アナログコードレス電話システムやディジタルコードレス電話システム、ディジタル自動車・携帯電話システムなどの移動通信システムに係わり、特に無線チャネル割当方式として自律分散形ダイナミック割当方式を採用したシステムの無線チャネル選択方法および基地局装置に関する。
【０００２】
【従来の技術】複数の基地局および複数の移動局を有する移動通信システムでは、周波数利用効率を高めるために、干渉が許容値以下になる距離以上離間して無線チャネルを繰り返し使用している。このような移動通信システムにおいて使用される無線チャネル割当方式には、固定チャネル割当（ＦＣＡ：Fixed Channel Asignment ）方式と、ダイナミックチャネル割当（ＤＣＡ：Dynamic Channel Assignment）方式とがある。
【０００３】ＦＣＡ方式は、予め各基地局に複数の無線

チャネルを固定的に配分しておき、移動局との間で通信を行なう際に基地局が自局に配分された上記無線チャネルの中から適当な無線チャネルを選択して割当てるものである。これに対しＤＣＡ方式は、移動局との間で通信を行なう際に、各基地局ともシステムが保有する全ての無線チャネルの中から適当な無線チャネルを選択して割当てるものである。ＤＣＡ方式は、ＦＣＡ方式と比較して回線設計が不要であるため、通信量に応じて柔軟に無線チャネルを割当てることができる利点を有する。

【０００４】ところで、このＤＣＡ方式により無線チャネルを選択する場合には、干渉が許容値以下の無線チャネルを選択する必要があるとともに、他の使用中の通信に影響を及ぼさないように考慮する必要がある。これらの条件を満足する無線チャネル選択方式としては、所定の距離以上離間していない基地局では同じ無線チャネルを使用しない方式や、同じ無線チャネルを使用した他の通信が存在する場合にこの通信に干渉を与えないことを確かめたのち無線チャネルを選択する方式がある。

【０００５】これらの選択方式では、無線チャネルを選択しようとする基地局が、同一の無線チャネルを使用している他の基地局との間で、直接あるいは制御局を通して間接的に制御信号の通信を行なって、無線チャネルを選択するための情報を得る必要がある。しかるに、基地局数が増加するとこの制御信号による通信量が急速に増大する。特にマイクロセルシステムでは基地局数が非常に多くなるため、このような方式による無線チャネルの選択は実際上困難である。

【０００６】そこで、マイクロセルシステムのための無線チャネル割当方式として、基地局間で制御信号の通信を行なわずに済む自律分散形のＤＣＡ方式の採用が検討されている。

【０００７】自律分散形ＤＣＡ方式は、各基地局が各々他の基地局との間で通信を行なわずに自局において得られる情報のみを用いて無線チャネルを選択するもので、この無線チャネルの選択を例えば次のように行なっている。なお、ここでは受信波レベルと干渉波レベルとの比率ＣＩＲ（Carrier to Interference Ratio）を用いて干渉の影響を評価する場合を例にとって説明を行なう。

【０００８】すなわち、自律分散形ＤＣＡ方式により無線チャネルを選択する場合に使用できる情報は、自基地局で得られる情報および自基地局と通信を行なう移動局で得られる情報に限られる。したがって、同一チャネルを使用する他の通信に与えるＣＩＲの劣化を直接評価することはできない。このため、ＣＩＲに十分なマージンを持つ無線チャネルを選択することにより、他の通信のＣＩＲが所要値よりも劣化する確率を低くする方式が用いられる。

【０００９】図６は、自律分散形ＤＣＡ方式による無線チャネル選択方法を説明するためのもので、基地局ＢＳ１と移動局ＰＳ１とがある無線チャネルを使用して通信を行なっているときに、基地局ＢＳ２と移動局ＰＳ２との間で同じ無線チャネルを使用しようとする場合を示している。なお、ここでは同じ無線チャネルを使用している通信数を１として説明するが、通信数が複数の場合には複数の干渉波を加算することにより同様にＣＩＲを測定可能である。

【００１０】先ず、上り回線および下り回線の両方のＣＩＲを測定して無線チャネルの使用可否を判定する方法について述べる。基地局ＢＳ２は、移動局ＰＳ２の送信波の受信レベルと、同一チャネルを使用している他の移動局ＰＳ１からの干渉波レベルとをそれぞれ測定し、これらのレベルを比較することにより上り回線のＣＩＲを求める。移動局ＰＳ２は、基地局ＢＳ２の送信波の受信レベルと、同一チャネルを使用している他の基地局ＢＳ１からの干渉波レベルとをそれぞれ測定し、これらのレベルを比較することにより下り回線のＣＩＲを求める。そして、基地局ＢＳ２は、これらの上り回線ＣＩＲおよび下り回線ＣＩＲがともにしきい値を満たす無線チャネルを使用可能なチャネルとする。

【００１１】以上の判定方法を数式を用いて表わすと次のようになる。すなわち、図６において、基地局ＢＳ１，ＢＳ２間の距離をＤ、基地局ＢＳ１と移動局ＰＳ１との間の距離をｒ１、基地局ＢＳ２と移動局ＰＳ２との間の距離をｒ２とし、さらに基地局ＢＳ１から移動局ＰＳ２への伝播損失をＬ１２、移動局ＰＳ１から基地局ＢＳ２への伝播損失をＬ２１、移動局ＰＳ２から基地局ＢＳ２への伝播損失をＬ２２とする。そうすると、移動局ＰＳ２から基地局ＢＳ２へ向かう上り回線のＣＩＲ、および基地局ＢＳ２から移動局ＰＳ２に向かう下り回線のＣＩＲは、それぞれ次式で表わされる。

【００１２】

$$\text{上り回線CIR} = L21 - L22 = 10\alpha \log \{ (D + r1) / |r2| \} \quad \cdots (1)$$

$$\text{下り回線CIR} = L12 - L22 = 10\alpha \log \{ (D - r2) / |r2| \} \quad \cdots (2)$$

ただし、αは伝播定数である。

【００１３】ここで、基地局ＢＳ１と移動局ＰＳ１との間で通信（通信１）が行なわれている状態で、同一チャネルを用いて基地局ＢＳ２と移動局ＰＳ２との間で通信（通信２）を行なうための条件は、上り回線ＣＩＲのしきい値をＴＨｒｕ［ｄＢ］、下り回線ＣＩＲのしきい値

をＴＨｒｄ［ｄＢ］とすると、

$$r2 \leq (D+r1)\,10^{-THru/10} \quad (r2>0)$$
$$r2 \geq -(D+r1)\,10^{-THru/10} \quad (r2<0) \quad \cdots(3)$$

$$r2 \leq D\,(10^{THrd/10}+1)^{-1} \quad (r2>0)$$
$$r2 \geq -D\,(10^{THrd/10}-1)^{-1} \quad (r2<0) \quad \cdots(4)$$

のように表わされる。

【００１４】基地局ＢＳ２は、システムが保有する各無線チャネルについてそれぞれこれらの第(3) 式および第(4) 式の条件を同時に満たすか否かを判定し、条件を満たす無線チャネルが見付かると、この無線チャネルを移動局ＰＳ２との間の通信に割当てる。

【００１５】なお、すべての基地局ＢＳ１，ＢＳ２の送信出力レベルおよびすべての移動局ＰＳ１，ＰＳ２の送信出力レベルはそれぞれ同一値に設定されているものと仮定すると、上記各伝播損失Ｌ２２，Ｌ２１，Ｌ１２は、それぞれ上記送信波の受信レベルおよび干渉波の受信レベルから求めることができる。なお、基地局ごとまたは移動局ごとに送信レベルが異なる場合にも、ＣＩＲを求めることは可能である。

【００１６】上記式に具体的な数値を代入すると次のようになる。すなわち、いま仮にＣＩＲしきい値をＴＨｒｕ＝ＴＨｒｄ＝２０ｄＢとすると、通信２が可能な範囲ｒ２は、上記第(3) 式および第(4) 式よりそれぞれ、

$$|r2| \leq 0.10\,r1 + 0.10\,D \quad \cdots[1]$$
$$-0.11\,D \leq r2 \leq 0.09\,D \quad \cdots[2]$$

となる。図７はこの条件を横軸ｒ１、縦軸ｒ２として示した図である。

【００１７】移動局ＰＳ１，ＰＳ２がそれぞれ［－０．５，０．５］に一様に分布するものと仮定すると、通信１が存在するときに通信２が可能となる確率Ｐｃは、図７中斜線イの面積で表わすことができ、

Ｐｃ＝０．１７４

となる。

【００１８】以上述べた上り回線および下り回線の両方のＣＩＲを基に無線チャネルの使用の可否を判定する方法は、上下回線のＣＩＲがともにしきい値を満たす無線チャネルを常に確実に選択できるので、回線品質を高く確保する上で有利である。しかし、その反面下り回線を評価するために、移動局ＰＳ２において測定を行なって、その測定結果あるいは評価結果を基地局ＢＳ２に転送する必要がある。このため、基地局ＢＳ２と移動局ＰＳ２との間の制御データ通信量の増大を招いたり、無線リンクの接続遅延を生じる欠点がある。

【００１９】次に、より単純な方法として上り回線のＣＩＲのみを測定して無線チャネルの使用の可否を判定する方法について述べる。基地局ＢＳ２は、移動局ＰＳ２の送信波の受信レベルと、同一チャネルを使用している他の移動局ＰＳ１からの干渉波レベルとをそれぞれ測定し、これらのレベルを比較することにより上り回線のＣＩＲを求める。そして、この上り回線ＣＩＲがしきい値を満たす無線チャネルを使用可能なチャネルとする。

【００２０】上記上り回線のＣＩＲは先に述べた第(1) 式で表わされ、さらに基地局ＢＳ１と移動局ＰＳ１との間で通信（通信１）が行なわれている状態で、同一チャネルを用いて基地局ＢＳ２と移動局ＰＳ２との間で通信（通信２）を行なうための条件は、前記第(3) 式のように表わされる。基地局ＢＳ２は、システムが保有する各無線チャネルについてそれぞれ上記第(3) 式の条件を満たすか否かを判定し、条件を満たす無線チャネルが見付かると、この無線チャネルを移動局ＰＳ２との間の通信に割当てる。

【００２１】この上り回線のＣＩＲのみを基に無線チャネルの使用の可否を判定する方法を用いた場合、通信２が可能な範囲ｒ２は前記第[1] 式で与えられる。図８はこの条件を横軸ｒ１、縦軸ｒ２として示した図であり、測定しない下り回線のしきい値を破線で示している。通信２が可能となる確立Ｐｃは、

Ｐｃ＝０．２００

となり、先に述べた上り回線および下り回線の両方のＣＩＲを基に無線チャネルの使用の可否を判定する方法（Ｐｃ＝０．１７４）よりも増加する。

【００２２】しかし、上り回線のＣＩＲのみを基に無線チャネルの使用の可否を判定する方法では、図８に示すごとく下り回線のＣＩＲがしきい値を満たさない領域Ｒが存在する。ここで、前記第(2) 式を用いてＣＩＲの最小値を求めると１５．１ｄＢとなり、前記上り回線および下り回線の両方のＣＩＲを基に無線チャネルの使用の可否を判定する方法よりも４．９ｄＢ減少する。無線チャネルを選択する際に、前記上り回線および下り回線の各ＣＩＲを基に無線チャネルの使用の可否を判定する方法の場合と同じＣＩＲの最小値を確保しようとすると、上り回線のＣＩＲを高く設定しなければならない。この条件を満たすＣＩＲしきい値ＴＨｒｕは前記第(3) 式より、

ＴＨｒｕ＝２４．４ｄＢ

となり、４．４ｄＢ高く設定しなければならないことになる。

【００２３】この条件を適用すると、通信２が可能な範囲ｒ２は、

$$|r2| \leq 0.06\,r1 + 0.06\,D \quad \cdots[1']$$

となる。この条件を図８中に矢印で示す。このときの通信１が存在するときに通信２が可能となる確率Ｐｃは、
Ｐｃ＝０．１２０
となり、前記上り回線および下り回線の各ＣＩＲを基に無線チャネルの使用の可否を判定する方法に比べて減少する。

【００２４】このように上り回線のＣＩＲのみに基づいて無線チャネルの使用の可否を判定する方法は、移動局ＰＳ２において受信波の測定を行なう必要がなく、また基地局ＢＳ２と移動局ＰＳ２との間で制御データの転送を行なう必要がないので、制御チャネルにおける通信量の増加や接続遅延の発生を招く心配がない。しかし、下り回線ＣＩＲがしきい値よりも小さくなる可能性がある。このため、先に述べた上り回線および下り回線の各ＣＩＲをそれぞれ測定する場合と同じ下り回線ＣＩＲを確保するためには、上り回線ＣＩＲのしきい値を高く設定する必要がある。上り回線ＣＩＲのしきい値を高く設定すると、同一チャネルを使用する通信間の距離が増加することになるため、移動通信システムの収容可能呼量が減少して周波数利用効率の低下を招く。

【００２５】
【発明が解決しようとする課題】以上説明したように、自律分散形ダイナミックチャネル割当方式を用いて無線チャネルを選択する場合、無線チャネルの使用の可否を判定する方法としては、上り回線および下り回線の両方のＣＩＲを基に判定する方法と、上り回線のＣＩＲのみを基に判定する方法とがある。しかし、前者は回線品質を高く確保できるという利点を有する反面、基地局ＢＳ２と移動局ＰＳ２との間の制御データ通信量の増大を招いたり、無線リンクの接続遅延を生じる欠点を有する。一方後者は、制御チャネルにおける通信量の増加や接続遅延の発生は生じないが、しきい値を高く設定する必要があるためシステムの収容可能呼量が減少して周波数利用効率の低下を招くという欠点を有する。

【００２６】本発明は以上のような事情に着目してなされたもので、その目的とするところは、無線チャネルを割り当てる際に、制御チャネルにおける通信量の増加や接続遅延の発生を生じずに、しかも収容可能呼量を多く確保して周波数利用効率を高めることができる移動通信システムの無線チャネル選択方法および基地局装置を提供することにある。

【００２７】
【課題を解決するための手段】上記目的を達成するために本発明の無線チャネル選択方法は、接続対象の基地局と移動局との間を接続するための無線チャネルを選択する際に、複数の無線チャネルのうちの任意の無線チャネルを介して上記接続対象の移動局から到来した搬送波の受信レベルと、上記任意の無線チャネルと同一の無線チャネルを介して他の移動局および他の基地局からそれぞれ到来した搬送波の受信レベルとを上記接続対象の基地局でそれぞれ測定し、この測定された上記接続対象の移動局から到来した搬送波の受信レベルと上記他の移動局から到来した搬送波の受信レベルとに基づいて、上記接続対象の移動局から接続対象の基地局に向かう上り回線の受信波対干渉波比を求めるとともに、上記測定された上記接続対象の移動局から到来した搬送波の受信レベルと上記他の基地局から到来した搬送波の受信レベルとに基づいて、上記接続対象の基地局から上記接続対象の移動局へ向かう下り回線の受信波対干渉波比を推定し、この求められた上り回線の受信波対干渉波比および下り回線の推定受信波対干渉波比に基づいて上記任意の無線チャネルの使用の可否を判定するようにしたものである。

【００２８】一方、上記目的を達成するために本発明の基地局装置は、受信レベル測定手段と、第１および第２の干渉検出手段と、判定手段とを備えている。そして、受信レベル測定手段において、上記複数の移動局の一つとの間を接続するための無線チャネルを選択する際に、上記複数の無線チャネルのうちの任意の無線チャネルを介して上記接続対象の移動局から到来した搬送波の受信レベルと、上記任意の無線チャネルと同一の無線チャネルを介して他の移動局および他の基地局装置からそれぞれ到来した搬送波の受信レベルとをそれぞれ測定し、この測定された上記接続対象の移動局から到来した搬送波の受信レベルと上記他の移動局から到来した搬送波の受信レベルとに基づいて、上記第１の干渉検出手段により上記接続対象の移動局から自己の基地局装置に向かう上り回線の受信波対干渉波比を求めるとともに、測定された上記接続対象の移動局から到来した搬送波の受信レベルと上記他の基地局装置から到来した搬送波の受信レベルとに基づいて、上記第２の干渉検出手段により自己の基地局装置から上記接続対象の移動局へ向かう下り回線の受信波対干渉波比を推定し、この求められた上り回線の受信波対干渉波比および下り回線の推定受信波対干渉波比に基づいて上記任意の無線チャネルの使用の可否を判定するようにしたものである。

【００２９】また本発明の基地局装置は、複数の基地局装置の送信レベルおよび複数の移動局の送信レベルがそれぞれ同一値に設定されている場合に、上記第１の干渉検出手段において、接続対象の移動局から到来した搬送波の受信レベルと上記移動局の送信レベルとから上記接続対象の移動局から自己の基地局装置へ向かう伝送路の伝播損失を求めるとともに、他の移動局から到来した搬送波の受信レベルと上記移動局の送信レベルとから上記他の移動局から自己の基地局装置へ向かう伝送路の伝播損失を求め、これらの伝播損失の差を基に上記接続対象の移動局から自己の基地局装置に向かう上り回線の受信波対干渉波比を求めることも特徴としている。

【００３０】さらに本発明の基地局装置は、複数の基地局装置の送信レベルおよび複数の移動局の送信レベルがそれぞれ同一値に設定されている場合に、第２の干渉検

出手段において、接続対象の移動局から到来した搬送波の受信レベルと上記移動局の送信レベルとから上記接続対象の移動局から自己の基地局へ向かう伝送路の伝播損失を求めるとともに、他の基地局から到来した搬送波の受信レベルと上記基地局装置の送信レベルとから上記他の基地局装置から自己の基地局装置へ向かう伝送路の伝播損失を求め、これらの伝播損失の差を基に自己の基地局装置から上記接続対象の移動局に向かう下り回線の受信波対干渉波比を推定することも特徴としている。

【００３１】

【作用】この結果本発明の無線チャネル選択方法および基地局装置によれば、接続対象の基地局装置から接続対象移動局に向かう下り回線の受信波対干渉波比（ＣＩＲ）が、同一無線チャネルを使用している他の基地局装置から到来した搬送波の受信レベルを基に推定され、この推定された下り回線のＣＩＲと上り回線のＣＩＲとに基づいて無線チャネルの使用の可否が判定される。

【００３２】したがって、基地局装置における受信レベルの測定のみで無線チャネルの使用の可否を判定することが可能となり、接続対象移動局における受信レベルの測定やこの接続対象移動局から基地局装置への測定データの転送は不要となる。このため、制御チャネルにおける通信量の増加や接続遅延の発生は低減される。また、無線チャネルの使用可否の判定に、上り回線のＣＩＲ測定値だけでなく下り回線のＣＩＲ推定値も使用されるので、上り回線のＣＩＲ測定値のみを用いて判定する場合に比べて正確な判定を行なうことが可能となる。このため、ＣＩＲ判定のためのしきい値を高く設定する必要がなくなり、これにより同一チャネルを使用した通信間の距離を短くすることが可能となって、移動通信システムの収容可能呼量の増加、延いては周波数利用効率の向上を図ることができる。

【００３３】また、複数の基地局装置の送信レベルおよび複数の移動局の送信レベルがそれぞれ同一値に設定されている場合に、各伝送路の伝搬損失を受信レベルのみから容易に求めることができ、これにより上り回線および下り回線のＣＩＲの算出、延いては無線チャネルの使用可否の判定を簡単に行なうことができる。

【００３４】

【実施例】図１は、本発明の一実施例に係わる移動通信システムの基地局の構成を示す回路ブロック図である。同図において、図示しない移動局から到来した無線周波信号は、アンテナ１１で受信されたのち無線部１の高周波スイッチ（ＳＷ）１２を介して受信部１３に入力される。この受信部１３では、上記受信された無線周波信号が周波数シンセサイザ１４から発生された受信局部発振信号とミキシングされて、受信中間周波信号に周波数変換される。なお、上記周波数シンセサイザ１４から発生される局部発振周波数は、無線チャネル周波数に応じて制御部６より指示される。また、無線部１には受信電界強度検出部（ＲＳＳＩ）１６が設けられている。この受信電界強度検出部１６では、移動局および他の基地局から到来した無線搬送波の受信電界強度が検出され、その検出値は後述する無線チャネル選択制御のために制御部６に通知される。

【００３５】上記受信部１３から出力された受信中間周波信号は、モデム部２の復調部２１に入力される。復調部２１では上記受信中間周波信号のディジタル復調が行なわれ、これによりディジタル通話信号が再生される。ＴＤＭＡ部３のＴＤＭＡデコード部３１では、制御部６の指示に従って無線チャネルのタイムスロットごとにディジタル通話信号が分解され、この分解されたディジタル通話信号は通話部４に入力される。

【００３６】通話部４は、チャネルコーデック（ＣＨ－ＣＯＤＥＣ）４１と、スピーチコーデック（ＳＰ－ＣＯＤＥＣ）４２とを備えている。上記ＴＤＭＡデコード部３１から出力されたディジタル通話信号は、先ずチャネルコーデック４１で誤り訂正復号処理が行なわれたのち、スピーチコーデック４２に入力されて音声復号処理される。そして、これらの復号処理により再生された通話信号は、ハイブリッド回路を有する回線インタフェース５から有線回線ＣＬを介して図示しない移動通信用の制御局へ送出される。

【００３７】これに対し、有線回線ＣＬを介して制御局から到来した通話信号は、回線インタフェース５を介して通話部４のスピーチコーデック４２に入力される。そして、このスピーチコーデック４２で音声符号化処理されたのち、チャネルコーデック４１で誤り訂正符号化されて、ＴＤＭＡ部３のＴＤＭＡエンコード部３２に入力される。

【００３８】ＴＤＭＡエンコード部３２は、上記チャネルコーデック４１から出力された符号化ディジタル通話信号を、通信相手の移動局に割り当てたタイムスロットに挿入し、この符号化ディジタル通話信号を変調部２２に入力する。変調部２２では、上記符号化ディジタル通話信号により搬送波信号がディジタル変調され、この変調された搬送波信号は送信部１５に入力される。送信部１５は、上記変調された搬送波信号を周波数シンセサイザ１４から発生された送信局部発振信号とミキシングすることにより、制御部６により指示された無線チャネル周波数に周波数変換し、さらに所定の送信電力レベルに増幅する。そして、この送信部１５から出力された無線周波信号は、高周波スイッチ１２を介してアンテナ１１から図示しない通信相手の移動局に向け送信される。

【００３９】ところで、制御部６は例えばマイクロコンピュータを主制御部としたもので、無線チャネル接続制御などの通常の制御機能に加えて、自律分散形ダイナミック割当方式を適用した無線チャネル選択制御手段を備えている。

【００４０】この無線チャネル選択制御手段は、無線チ

ャネルを選択する際に、接続対象の移動局からの受信波レベル、同一無線チャネルを使用している他の移動局からの干渉波受信レベル、および同一無線チャネルを使用している他の基地局からの受信レベルをそれぞれ受信電界強度検出部１６を介して測定する。そして、これらの受信レベル測定値から各伝送路の伝播損失を算出し、この伝播損失を基に接続相手の移動局との間の上り回線ＣＩＲを求めるとともに、下り回線のＣＩＲを推定する。さらに、これら上り回線のＣＩＲ算出値および下り回線のＣＩＲ推定値をそれぞれしきい値と比較し、これにより上記無線チャネルの使用の可否を判定する。

【００４１】次に、以上のように構成された基地局による無線チャネル選択制御動作を説明する。図２および図３はその制御手順および制御内容を示すフローチャートである。

【００４２】いま、例えば図５に示すごとく基地局ＢＳ１と移動局ＰＳ１とがある無線チャネルを使用して通信を行なっているときに、基地局ＢＳ２と移動局ＰＳ２との間で同じ無線チャネルの使用を試みるものとする。

【００４３】基地局ＢＳ２の制御部６は、図２に示すごとくステップ２ａで上記無線チャネルを仮選択して接続対象の移動局ＰＳ２に指定する。そして、この状態で先ずステップ２ｂで接続対象の移動局ＰＳ２から到来する搬送波の受信波レベルを受信電界強度検出部１６を介して測定し、次にステップ２ｃで同一の無線チャネルを使用している他の移動局ＰＳ１から到来する干渉波の受信レベルを受信電界強度検出部１６を介して測定し、さらにステップ２ｄにおいて同一の無線チャネルを使用している他の基地局ＢＳ１から到来する搬送波の受信レベルを受信電界強度検出部１６を介して測定する。

【００４４】ここで、いま仮にシステムの全基地局の送信電力レベルは等しくかつ全移動局の送信電力レベルも等しいものとすると、上記各受信レベルの測定値から伝播損失を簡単に求めることができる。そこで、基地局ＢＳ２の制御部６は、ステップ２ｅにおいて、接続対象の移動局ＰＳ２から自己の基地局ＢＳ２に向かう上り回線の伝送損失Ｌ２２を、上記接続対象の移動局ＰＳ２から到来する搬送波の受信波レベルから求め、また他の移動局ＰＳ１から自己の基地局ＢＳ２までの間の伝播損失Ｌ２１を、上記他の移動局ＰＳ１から到来する干渉波の受信レベルから求め、さらに他の基地局ＢＳ１から自己の基地局ＢＳ２までの間の伝播損失Ｌｄを、上記他の基地局ＢＳ１から到来する搬送波の受信レベルから求める。

【００４５】そうして伝播損失Ｌ２２，Ｌ２１，Ｌｄが求められると、制御部６は先ずステップ２ｆにて上り回線のＣＩＲを算出し、さらにステップ２ｇにより上り回線の通話条件を表わす式を求める。すなわち、上り回線ＣＩＲは、先に述べた第(1)式、つまり

上り回線ＣＩＲ＝Ｌ２１－Ｌ２２

＝１０αｌｏｇ｛（Ｄ＋ｒ１）／｜ｒ２｜｝

により求められる。

【００４６】また、基地局ＢＳ１と移動局ＰＳ１との間で通信が行なわれている状態で、同一チャネルを用いて基地局ＢＳ２と移動局ＰＳ２との間で新たに通信を行なうための上り回線におけるＣＩＲ条件は、先に述べた第(3)式、つまり

$$r_2 \leqq (D+r_1)\,10^{-THru/10} \quad (r_2>0)$$

$$r_2 \geqq -(D+r_1)\,10^{-THru/10} \quad (r_2<0)$$

により表わされる。

【００４７】制御部６は、次にステップ２ｈにおいて今度は移動局ＰＳ２から基地局ＢＳ２に向かう上り回線のＣＩＲを推定し、さらにステップ２ｉにおいて上記下り回線の推定ＣＩＲから次のように推定される。

下り回線の推定ＣＩＲ＝Ｌｄ－Ｌ２２

＝１０αｌｏｇ（Ｄ／｜ｒ２｜）　　…(2')

また、基地局ＢＳ１と移動局ＰＳ１との間で通信が行なわれている状態で、同一チャネルを用いて基地局ＢＳ２と移動局ＰＳ２との間で新たに通信を行なうための下り回線におけるＣＩＲの条件は、下り回線の推定ＣＩＲ≧ＴＨｒｄ、上記第(2')式より、

$$r_2 \leqq D \cdot 10^{-THrd/10} \quad (r_2>0)$$

$$r_2 \geqq -D \cdot 10^{-THrd/10} \quad (r_2<0) \qquad \cdots(4')$$

のように表わされる。

【００４８】次に制御部６は、図３に示すごとくステップ３ａにおいて上記第(3)式を基に上り回線が通話可能条件を満たしているか否かを判定し、さらにステップ３ｂにおいて上記第(4')式を基に下り回線が通話可能条件を満たしているか否かを判定する。そして、上り回線および下り回線の両方の条件を満足すると判定された場合には、ステップ３ｃに移行してここで先に仮選択した無線チャネルを正式に選択して移動局ＰＳ２に指定し、無線チャネル選択制御を終了する。

【００４９】これに対し、上記上り回線および下り回線のいずれか一方で通話可能条件を満たさないと判定された場合には、制御部６はステップ３ｄに移行して、ここでシステムが保有する全無線チャネルの中でまだ選択していない無線チャネルが残っているか否かを判定する。そして、未選択の無線チャネルが残っている場合にはステップ３ｅに移行し、ここで次の未選択の無線チャネルを仮選択して移動局ＰＳ２に指定し、しかるのち図２の

ステップ２ｂに戻って以後同様の制御を実行する。

【００５０】このようにして無線チャネルの使用可否を判定すると次のような効果が奏せられる。すなわち、前記推定された下り回線の通話条件式つまり第(4')式は、移動局ＰＳ２において実際に受信レベルを測定することにより得た下り回線の通話条件式つまり前記第(4) 式と平行である。このため、しきい値ＴＨｒｄを多少変更するだけで、実際に測定した場合に近い精度で下り回線の

$$|r2| \leq 0.10D$$

と、前記上記第(3) 式より求めた

$$|r2| \leq 0.10r1 + 0.10D \quad \cdots[1]$$

とにより与えられる。図４はこの条件を横軸ｒ１、縦軸ｒ２として示した図である。同図において、破線は本実施例の方法では測定しない実際の下り回線ＣＩＲのしきい値[2] を示しており、上記推定ＣＩＲに基づいて求めた[5] はこの[2]に近いものとなる。

【００５２】また、基地局ＢＳ１と移動局ＰＳ１との間の通信１が存在する状態で、同一の無線チャネルを使用して基地局ＢＳ２と移動局ＰＳ２との間で新たな通信２を行なえる確率Ｐｃは、

Ｐｃ＝０．１７５

となり、実際に測定した場合のＰｃ＝０．１７４とほぼ等しくなる。

【００５３】本実施例では、図４に示すごとく下り回線

$$|r2| \leq 0.09D$$

となる。この条件[5']を図４中に示す。

【００５５】また、通信１が存在する状態で同一の無線チャネルを使用した通信２が可能となる確率Ｐｃは、

Ｐｃ＝０．１６４

となり、上り回線ＣＩＲのみを用いて無線チャネルの使用可否を判定する場合（Ｐｃ＝０．１２０）に比べて十分に高くなる。

【００５６】すなわち、本実施例の無線チャネル選択方法では、実際に測定した上り回線のＣＩＲ値と、他の基地局ＢＳ１からの搬送波受信レベルを基に推定した下り回線ＣＩＲ値とを使用して無線チャネルの使用可否を判定しているので、下り回線ＣＩＲを用いずに上り回線ＣＩＲ値のみを用いて判定を行なう場合に比べて、正確な判定を行なうことができる。したがって、ＣＩＲ判定のためのしきい値を高く設定する必要がなくなり、これにより同一チャネルを使用した通信間の距離を短くすることが可能となって、システムの収容可能呼量の増加、延いては周波数利用効率の向上を図ることができる。

【００５７】しかも、基地局ＢＳ２における測定だけで判定できるので、接続対象移動局ＰＳ２における受信レベルの測定やこの接続対象移動局ＰＳ２から基地局ＢＳ２への測定データの転送は不要となる。このため、制御チャネルにおける通信量の増加や接続遅延の発生を低減することができる。

【００５８】なお、本発明は上記実施例に限定されるも

使用可否を判定することが可能である。

【００５１】具体的な数値を代入して、下り回線のＣＩＲを実際に測定した場合と比較すると次のようになる。すなわち、いま仮にＣＩＲしきい値を

ＴＨｒｕ＝ＴＨｒｄ＝２０ｄＢ

に設定したとする。そうすると、移動局ＰＳ２と基地局ＢＳ２との間の通信２が成立する範囲ｒ２は、上記第(4')式より求めた

$$\cdots[5]$$

ＣＩＲのしきい値を満たさない領域ハが存在するが、第(2) 式を用いて最小のＣＩＲ値を求めると１９．１ｄＢとなり、実際に測定した場合の最小のＣＩＲ値である２０ｄＢよりも０．９ｄＢだけ減少したものとなる。

【００５４】ここで、無線チャネルを選択するときに、上り回線と下り回線のＣＩＲを実際に測定した場合と同じ最小ＣＩＲ値が必要だとすると、ＣＩＲしきい値を２０ｄＢよりも高めに設定しなければならない。しかし、条件を満たすしきい値ＴＨｒｄは、上記第(4')式より

ＴＨｒｄ＝２０．９ｄＢ

となり、しきい値ＴＨｒｄを高く設定することはほとんど不要となる。このときのｒ２は、

$$\cdots[5']$$

のではない。例えば、上記実施例では各基地局および移動局の送信電力レベルがそれぞれ等しいシステムに本発明を適用した場合を例にとって説明したが、基地局によってあるいは移動局によって送信電力レベルが異なるシステムにも適用できる。この場合には、移動局の送信電力レベルを基地局に伝えてその値と受信レベルとから伝播損失を求め、さらにこの伝播損失と他の基地局の送信レベルとから移動局受信レベルを求める。そして、この受信レベルを、基地局で測定した他の基地局の受信レベルと比較することにより下り回線ＣＩＲ値を求めることができる。

【００５９】また、本発明の無線チャネル選択方法は、上り回線と下り回線とで同一の無線周波数を使用するＴＤＤ（Time Division Duplex）方式のシステムにおいて特に有効である。しかし、それに限らず、通常の受信機の他に周波数の異なる下り回線の信号レベルを測定するための設備を設けることにより、上り回線と下り回線とで異なる無線周波数を使用するＦＤＤ（Frequency Division Duplex ）方式のシステムにも適用することが可能である。

【００６０】その他、基地局の回路構成、無線チャネル選択制御手段の制御手順および制御内容、移動通信システムの種類等についても、本発明の要旨を逸脱しない範囲で種々変形して実施できる。

【００６１】

【発明の効果】以上詳述したように本発明の無線チャネル選択方法では、接続対象の基地局と移動局との間を接続するための無線チャネルを選択する際に、複数の無線チャネルのうちの任意の無線チャネルを介して上記接続対象の移動局から到来した搬送波の受信レベルと、上記任意の無線チャネルと同一の無線チャネルを介して他の移動局および他の基地局からそれぞれ到来した搬送波の受信レベルとを上記接続対象の基地局でそれぞれ測定し、この測定された上記接続対象の移動局から到来した搬送波の受信レベルと上記他の移動局から到来した搬送波の受信レベルとに基づいて、上記接続対象の移動局から接続対象の基地局に向かう上り回線の受信波対干渉波比を求めるとともに、上記測定された上記接続対象の移動局から到来した搬送波の受信レベルと上記他の基地局から到来した搬送波の受信レベルとに基づいて、上記接続対象の基地局から上記接続対象の移動局へ向かう下り回線の受信波対干渉波比を推定し、この求められた上り回線の受信波対干渉波比および下り回線の推定受信波対干渉波比に基づいて上記任意の無線チャネルの使用の可否を判定するようにしている。

【００６２】また本発明の基地局装置では、受信レベル測定手段と、第１および第２の干渉検出手段と、判定手段とを備えている。そして、受信レベル測定手段において、上記複数の移動局の一つとの間を接続するための無線チャネルを選択する際に、上記複数の無線チャネルのうちの任意の無線チャネルを介して上記接続対象の移動局から到来した搬送波の受信レベルと、上記任意の無線チャネルと同一の無線チャネルを介して他の移動局および他の基地局装置からそれぞれ到来した搬送波の受信レベルとをそれぞれ測定し、この測定された上記接続対象の移動局から到来した搬送波の受信レベルと上記他の移動局から到来した搬送波の受信レベルとに基づいて、上記第１の干渉検出手段により上記接続対象の移動局から自己の基地局装置に向かう上り回線の受信波対干渉波比を求めるとともに、測定された上記接続対象の移動局から到来した搬送波の受信レベルと上記他の基地局装置から到来した搬送波の受信レベルとに基づいて、上記第２の干渉検出手段により自己の基地局装置から上記接続対象の移動局へ向かう下り回線の受信波対干渉波比を推定し、この求められた上り回線の受信波対干渉波比および下り回線の推定受信波対干渉波比に基づいて上記任意の無線チャネルの使用の可否を判定するようにしている。

【００６３】したがって本発明の無線チャネル選択方法および基地局装置によれば、無線チャネルを割り当てる際に、制御チャネルにおける通信量の増加や接続遅延の発生を生じずに、しかも収容可能呼量を多く確保して周波数利用効率を高めることができる移動通信システムの無線チャネル選択方法および基地局装置を提供することができる。

【図面の簡単な説明】

【図１】本発明の一実施例に係わる移動通信システムで使用される基地局の構成を示す回路ブロック図。

【図２】図１に示した基地局の制御部による無線チャネル選択制御の手順および内容の前半部分を示すフローチャート。

【図３】図１に示した基地局の制御部による無線チャネル選択制御の手順および内容の後半部分を示すフローチャート。

【図４】上り回線ＣＩＲおよび推定した下り回線ＣＩＲを基に判定を行なう場合の回線測定の特性を示す図。

【図５】本発明の一実施例における無線チャネルの使用可否の判定のために測定する回線の説明図。

【図６】従来における無線チャネルの使用可否の判定のために測定する回線の説明図。

【図７】従来における上り回線ＣＩＲおよび下り回線ＣＩＲを基に判定を行なう場合の回線測定の特性を示す図。

【図８】従来における上り回線ＣＩＲのみを基に判定を行なう場合の回線測定の特性を示す図。

【符号の説明】

ＢＳ１，ＢＳ２…基地局　　ＰＳ１，ＰＳ２…移動局

１…無線部　　２…モデム部

３…ＴＤＭＡ部　　４…通話部

５…回線インタフェース　　６…制御部

１１…アンテナ　　１２…高周波スイッチ

１３…受信部　　１４…周波数シンセサイザ

１５…送信部　　１６…受信電界強度検出部（ＲＳＳＩ）

２１…復調部　　２２…変調部

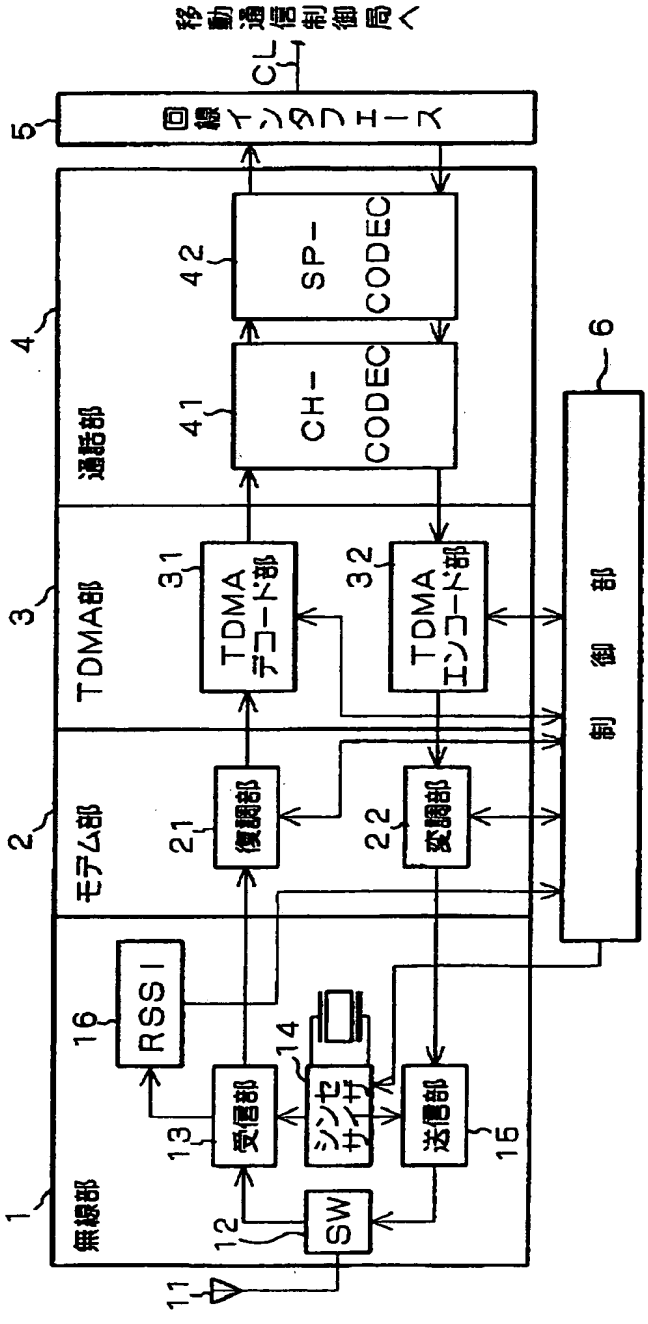
３１…ＴＤＭＡデコード部　　３２…ＴＤＭＡエンコード部

４１…チャネルコーデック（ＣＨ－ＣＯＤＥＣ）

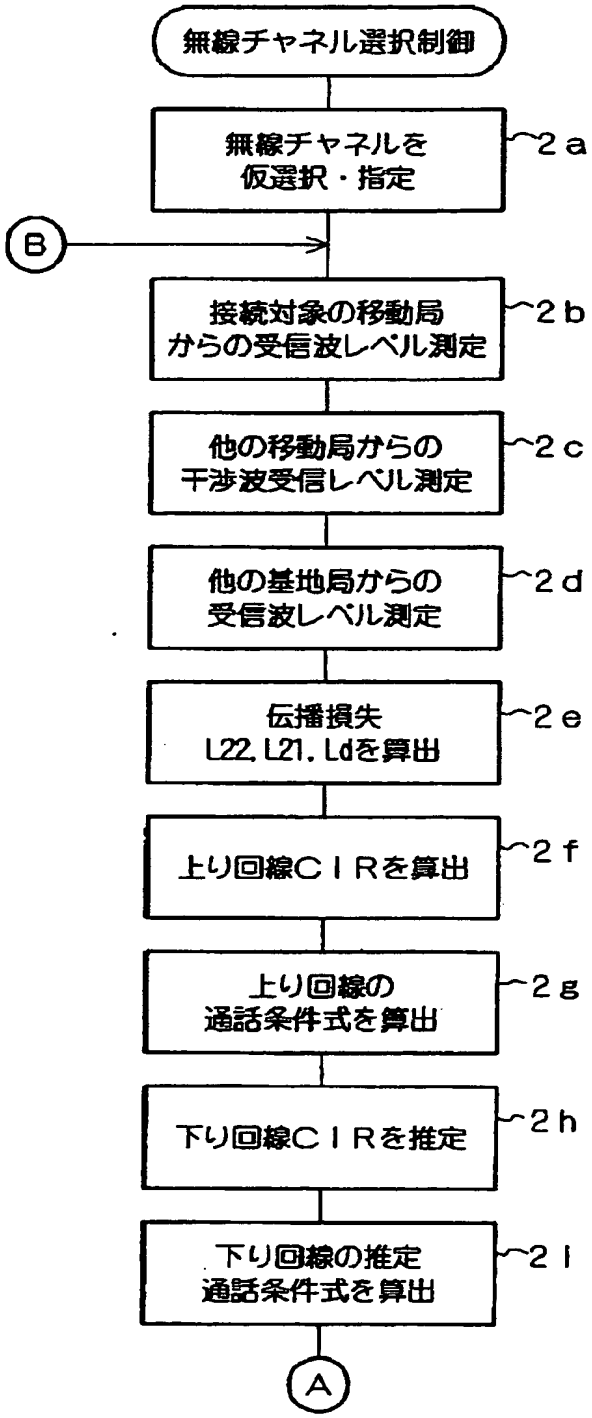
４２…スピーチコーデック（ＳＰ－ＣＯＤＥＣ）

Ｌ２１，Ｌ２２，Ｌｄ…伝播損失

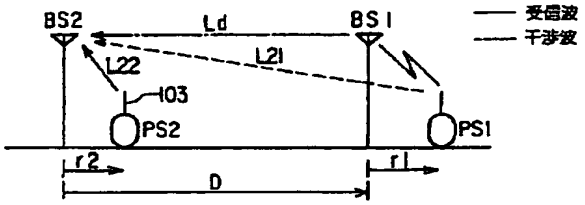
【図１】


移動通信制御局へ
CL
回線インタフェース
5
通話部
4
42
SP-CODEC
41
CH-CODEC
TDMA部
3
31
TDMAデコード部
32
TDMAエンコード部
モデム部
2
21
復調部
22
変調部
制御部
6
無線部
1
16
RSSI
14
シンセサイザ
13
受信部
15
送信部
12
SW
11

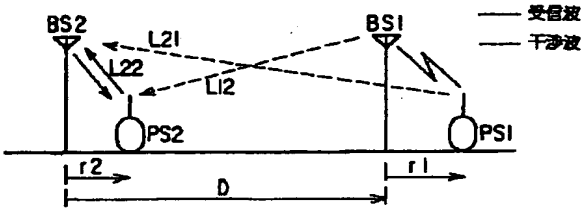
【図２】



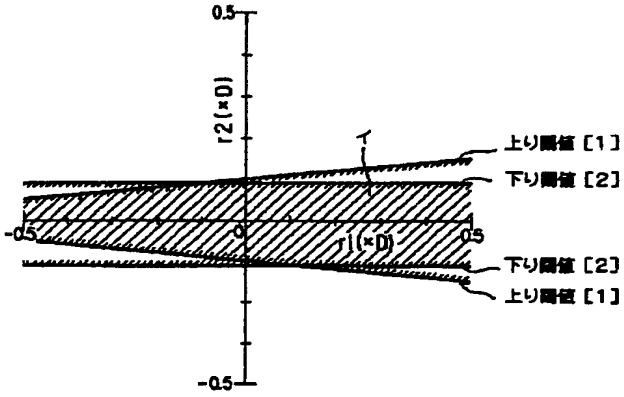
【図５】



【図６】

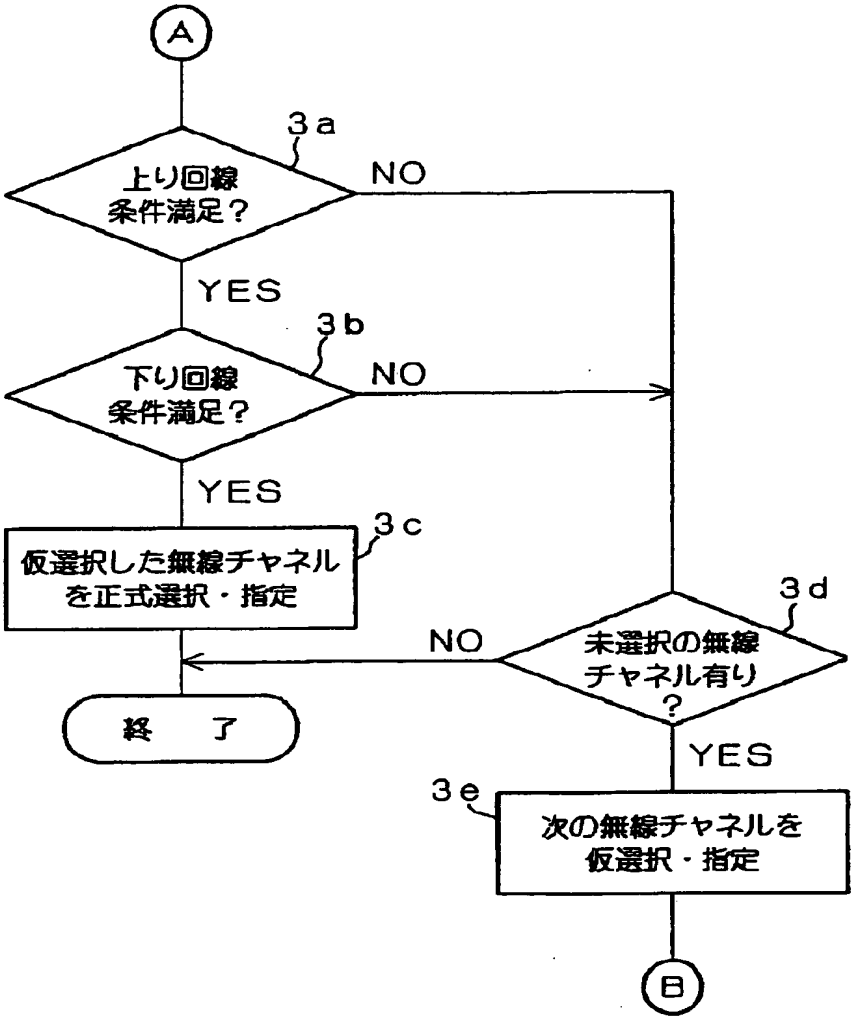


【図７】

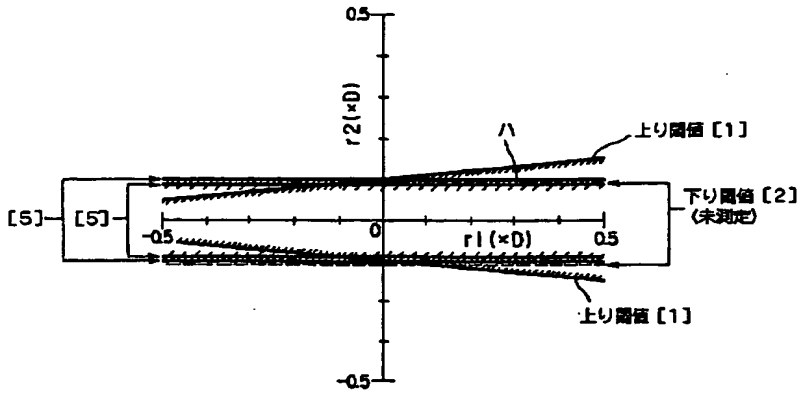


上り回線ＣＩＲおよび下り回線ＣＩＲを基に判定する場合

【図３】

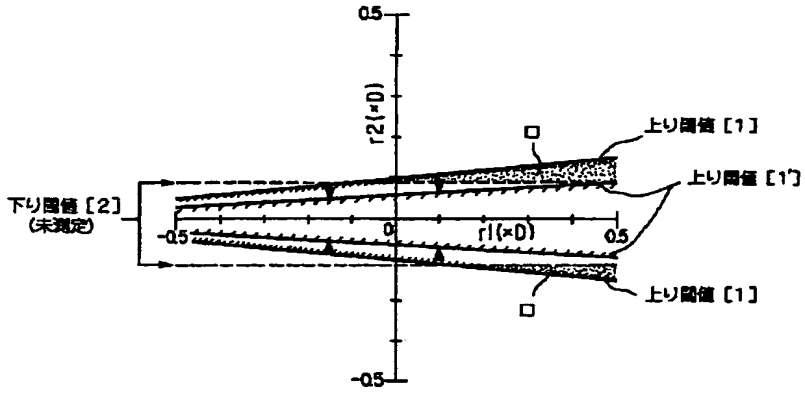

A
3a
上り回線
条件満足？
NO
YES
3b
下り回線
条件満足？
NO
YES
3c
仮選択した無線チャネル
を正式選択・指定
3d
未選択の無線
チャネル有り
？
NO
YES
終　了
3e
次の無線チャネルを
仮選択・指定
B

【図４】



上り回線ＣＩＲおよび推定した下り回線ＣＩＲ
を基に判定する場合

【図８】



上り回線ＣＩＲのみに基づいて判定する場合

JAPANESE [JP,08-223106,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the wireless channel selection approach which is in the migration communication system which has two or more base stations and two or more mobile stations, chooses a radio channel suitable out of two or more radio channels, and connects between said each base station and each mobile station In case the radio channel for connecting between said each base station and the base station for [of each mobile station] connection, and mobile stations is chosen The receiving level of the subcarrier which came from the mobile station for [said] connection through the radio channel of the arbitration of said two or more radio channels, The process which measures the receiving level of the subcarrier which came from other mobile station and other base stations through the same radio channel as the radio channel of said arbitration, respectively in the base station for [said] connection, respectively, It is based on the receiving level of the subcarrier which came from the mobile station for [which was measured / said] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. The process which asks for the received wave pair interference wave ratio of the going-up circuit which goes to the base station for connection from the mobile station for [said] connection, It is based on the receiving level of the subcarrier which came from the mobile station for [which was measured / said] connection, and the receiving level of the subcarrier which came from the base station besides the above. The process which faces to the mobile station for [said] connection from the base station for [said] connection and which gets down and presumes the received wave pair interference wave ratio of a circuit, The wireless channel selection approach of the migration communication system characterized by having the received wave pair interference wave ratio and the process which gets down and judges the propriety of use of the radio channel of said arbitration based on the presumed received wave pair interference wave ratio of a circuit of said going-up circuit.
[Claim 2] In said base station equipment which has two or more base station equipments and two or more mobile stations, and is used [radio channel / suitable out of two or more radio channels] in the migration communication system chosen and connected in between these each base station equipment and each mobile station The receiving level of the subcarrier which came from the mobile station for [said] connection through the radio channel of the arbitration of said two or more radio channels, The receiving level measurement means for measuring the receiving level of the subcarrier which came from other mobile station and other base station equipments through the same radio channel as the radio channel of said arbitration, respectively, respectively, It is based on the receiving level of the subcarrier which came from the mobile station for [which was measured by this receiving level measurement means / said] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. The 1st interference detection means for asking for the received wave pair interference wave ratio of the going-up circuit which faces to the base station equipment of self from the mobile station for [said] connection, It is based on the receiving level of the subcarrier which came from the mobile station for [which was measured by said receiving level measurement means / said] connection, and the receiving level of the subcarrier which came from base station equipment besides the above. 2nd interference detection means for getting down and presuming

the received wave pair interference wave ratio of a circuit to face to the mobile station for [said] connection from the base station equipment of self, Base station equipment of the migration communication system characterized by the thing which was acquired by said 1st and 2nd interference detection means, and which went up and possesses the received wave pair interference wave ratio of a circuit, and the judgment means for getting down and judging the propriety of use of the radio channel of said arbitration based on the presumed received wave pair interference wave ratio of a circuit.

[Claim 3] When the transmission level of two or more base station equipments and the transmission level of two or more mobile stations are set as the same value, respectively, the 1st interference detection means While searching for propagation loss of the transmission line which faces to the base station equipment of self from the mobile station for [said] connection from the receiving level of the subcarrier which came from the mobile station for connection, and the transmission level of said mobile station Propagation loss of the transmission line which faces to the base station equipment of self from a mobile station besides the above is searched for from the receiving level of the subcarrier which came from other mobile stations, and the transmission level of said mobile station. Base station equipment of the migration communication system according to claim 2 characterized by asking for the received wave pair interference wave ratio of the going-up circuit which faces to the base station equipment of self from the mobile station for [said] connection based on the difference of these propagation loss.

[Claim 4] When the transmission level of two or more base station equipments and the transmission level of two or more mobile stations are set as the same value, respectively, the 2nd interference detection means While searching for propagation loss of the transmission line which faces to the base station equipment of self from the mobile station for [said] connection from the receiving level of the subcarrier which came from the mobile station for connection, and the transmission level of said mobile station Propagation loss of the transmission line which faces to the base station equipment of self from base station equipment besides the above is searched for from the receiving level of the subcarrier which came from other base station equipments, and the transmission level of said base station equipment. Base station equipment of the migration communication system according to claim 2 characterized by the thing which face to the mobile station for [said] connection from the base station equipment of self based on the difference of these propagation loss, and for which it gets down and the received wave pair interference wave ratio of a circuit is presumed.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Especially this invention relates to the wireless channel selection approach and base station equipment of a system which adopted the autonomous distributed dynamic allocation method as a radio-channel allocation method with respect to migration communication system, such as an analog cordless telephones system, and a digital cordless telephones system, a digital automobile, a cellular-phone system.
[0002]
[Description of the Prior Art] In the migration communication system which has two or more base station and two or more mobile stations, in order to raise frequency use effectiveness, it estranges beyond the distance from which interference becomes below an allowed value, and the radio channel is repeated and used. There are a fixed channel allocation (FCA:Fixed Channel Asignment) method and a dynamic channel allocation (DCA:Dynamic Channel Assignment) method as radio-channel allocation method used in such migration communication system.
[0003] The FCA method distributes two or more radio channels to each base station fixed beforehand, and in case it communicates between mobile stations, it chooses and assigns a suitable radio channel out of the above-mentioned radio channel by which the base station was distributed to the local station. On the other hand, in case a DCA method communicates between mobile stations, it chooses and assigns each base station for a suitable radio channel out of all the radio channels that a system holds. Since the circuit design is unnecessary as compared with a FCA method, a DCA method has the advantage which can assign a radio channel flexibly according to traffic.
[0004] By the way, to choose a radio channel with this DCA method, while interference needs to choose the radio channel below an allowed value, it is necessary to consider that a communication link in use [other] is not affected. In the base station which has not been estranged beyond a predetermined distance as a wireless channel selection method with which are satisfied of these conditions, there are a method which does not use the same radio channel, and a method which chooses a radio channel after confirming not giving interference to this communication link, when other communication links which used the same radio channel exist.
[0005] It is necessary to communicate a control signal indirectly through direct or a control station, and to acquire the information for choosing a radio channel by these selection methods, among other base stations where the base station which is going to choose a radio channel is using the same radio channel. However, an increment of the number of base stations increases the traffic by this control signal quickly. Since the number of base stations especially increases very much in a microcell system, selection of the radio channel by such method is difficult in practice.
[0006] Then, adoption of the DCA method of autonomous distributed type which does not need to communicate a control signal between base stations is considered as a radio-channel allocation method for a microcell system.
[0007] what chooses a radio channel only using the information from which an autonomous distributed DCA method is obtained in a local station, without each base station communicating

between base stations besides each — it is — selection of this radio channel — for example, it is carrying out as follows. In addition, here explains taking the case of the case where the effect of interference is evaluated using the ratio CIR of received wave level and interference wave level (Carrier to Interference Ratio).

[0008] That is, the information which can be used when choosing a radio channel with an autonomous distributed DCA method is restricted to the information acquired with the mobile station which communicates with the information and the self-base station which are obtained in a self-base station. Therefore, the direct valuation of the degradation of CIR given to other communication links which use the same channel cannot be carried out. For this reason, the method which makes low the probability for CIR of other communication links to deteriorate rather than a necessary value is used by choosing a radio channel with sufficient margin for CIR.

[0009] Drawing 6 is for explaining the wireless channel selection approach by the autonomous distributed DCA method, and while communicating using the radio channel with a base station BS 1 and a mobile station PS 1, it shows the case where it is going to use the same radio channel between a base station BS 2 and a mobile station PS 2. In addition, although the number of communication links which is using the same radio channel here is explained as 1, when the number of communication links is plurality, it is measurable in CIR similarly by adding two or more interference waves.

[0010] First, a going-up circuit and the method of getting down, measuring CIR of both circuits and judging the use propriety of a radio channel are described. The receiving level of the transmission wave of a mobile station PS 2 and the interference wave level from other mobile stations PS 1 which are using the same channel are measured, respectively, it goes up by comparing such level, and a base station BS 2 calculates CIR of a circuit. A mobile station PS 2 measures the receiving level of the transmission wave of a base station BS 2, and the interference wave level from other base stations BS 1 which are using the same channel, respectively, gets down by comparing such level, and calculates CIR of a circuit. And a base station BS 2 uses as an usable channel these going-up circuits CIR and the radio channel with which it gets down and both the circuits CIR fill a threshold.

[0011] It is as follows when the above judgment approach is expressed using a formula. Namely, in drawing 6 , distance between r1, a base station BS 2, and a mobile station PS 2 is set [the distance between base stations BS / BS1 and / 2] to r2 for the distance between D, a base station BS 1, and a mobile station PS 1. Furthermore, propagation loss to the base station BS 2 from L21 and a mobile station PS 2 is set [the propagation loss to a mobile station PS 2] to L22 for the propagation loss to the base station BS 2 from L12 and a mobile station PS 1 from a base station BS 1. When it does so, CIR of the going-up circuit which goes to a base station BS 2 from a mobile station PS 2, and CIR of the going-down circuit which faces to a mobile station PS 2 from a base station BS 2 are expressed with a degree type, respectively.

[0012]

Uphill circuit CIR=L21-L22 = 10alphalog {(D+r1) /|r2|} — (1) It gets down and is circuit CIR=L12-L22. =10alphalog {(D-r2) /|r2|} — (2) However, alpha is a propagation coefficient.

[0013] Here in the condition that the communication link (communication link 1) is performed between the base station BS 1 and the mobile station PS 1 If the threshold of THru [dB] and the going-down circuit CIR is set to THrd [dB], the conditions for communicating between a base station BS 2 and a mobile station PS 2 using the same channel (communication link 2) the threshold of the going-up circuit CIR r2<= (D+r1) 10-THru/10 (r2> 0) r2 >=-(D+r1)10-THru/10 (r2<0) — (3) r2<= D (10THrd / 10 +1)-1 (r2> 0) r2 >=-D(10THrd/10 -1)-1 (r2<0) — (4) It is expressed like.

[0014] Base stations BS 2 are these ** (3) about each radio channel which a system holds, respectively. A formula and ** (4) It judges whether the conditions of a formula are fulfilled to coincidence, and if the radio channel which fulfills conditions is found, this radio channel will be assigned to the communication link between mobile stations PS 2.

[0015] In addition, if the transmitting output level of all the base stations BS1 and BS2 and the transmitting output level of all the mobile stations PS1 and PS2 are assumed to be what is set as the same value, respectively, each above-mentioned propagation loss L22, L21, and L12 can

be searched for from the receiving level of the above-mentioned transmission wave, and the receiving level of an interference wave, respectively. In addition, it is possible to calculate CIR, also when transmission levels differ for every base station and every mobile station.

[0016] It is as follows when a concrete numeric value is substituted for the above-mentioned formula. That is, if a CIR threshold is now set to THru=THrd=20dB, the range r2 in which communication link 2 is possible is ****** (3). A formula and ** (4) More respectively than a formula |r2|<=0.10r1+0.10D — [1] -0.11 D<=r2 <=0.09D — [2] It becomes. Drawing 7 is drawing having shown this condition as an axis of abscissa r1 and an axis of ordinate r2.

[0017] If it assumes that it is that from which mobile stations PS1 and PS2 are uniformly distributed over [-0.5 and 0.5], respectively, the probability Pc whose communication link 2 is attained when communication link 1 exists can be expressed with the area of slash I in drawing 7 R> 7, and will be set to Pc=0.174.

[0018] It had been stated above, and since both a circuit and the method of getting down and judging the propriety of use of a radio channel based on CIR of both circuits can always choose certainly the radio channel which fills a threshold, CIR of a vertical circuit is advantageous [the method] when securing circuit quality highly. On the other hand, in order to get down and to evaluate a circuit, it is necessary to measure in a mobile station PS 2 and to transmit the measurement result or an evaluation result to a base station BS 2. For this reason, increase of the control data traffic between a base station BS 2 and a mobile station PS 2 is caused, or there is a fault which produces the post-dialing delay of a radio link.

[0019] Next, how to go up as a simpler approach, to measure only CIR of a circuit, and to judge the propriety of use of a radio channel is described. The receiving level of the transmission wave of a mobile station PS 2 and the interference wave level from other mobile stations PS 1 which are using the same channel are measured, respectively, it goes up by comparing such level, and a base station BS 2 calculates CIR of a circuit. And this going-up circuit CIR uses as an usable channel the radio channel which fills a threshold.

[0020] CIR of the above-mentioned going-up circuit is ** (1) described previously. The conditions for being in the condition that it is expressed with a formula and the communication link (communication link 1) is further performed between the base station BS 1 and the mobile station PS 1, and communicating between a base station BS 2 and a mobile station PS 2 using the same channel (communication link 2) are said ** (3). It is expressed like a formula. A base station BS 2 is ****** (3) about each radio channel which a system holds, respectively. It judges whether the conditions of a formula are fulfilled, and if the radio channel which fulfills conditions is found, this radio channel will be assigned to the communication link between mobile stations PS 2.

[0021] When the approach of judging the propriety of use of a radio channel is used only based on CIR of this going-up circuit, the range r2 in which communication link 2 is possible is said ** [1]. It is given by the formula. Drawing 8 is drawing having shown this condition as an axis of abscissa r1 and an axis of ordinate r2, and shows the threshold of the going-down circuit which is not measured with the broken line. The establishment Pc whose communication link 2 is attained is set to Pc=0.200, had been described previously, and increases from a circuit and the method (Pc=0.174) of getting down and judging the propriety of use of a radio channel based on CIR of both circuits.

[0022] However, field RO to which it gets down as shown in drawing 8 , and CIR of a circuit does not fill a threshold with the approach of judging the propriety of the use of a radio channel only based on CIR of an uphill circuit exists. Here, it is said ** (2). If the minimum value of CIR is calculated using a formula, it will be set to 15.1dB and will decrease by 4.9dB rather than said going-up circuit and method of getting down and judging the propriety of use of a radio channel based on CIR of both circuits. If it is going to secure the minimum value of the same CIR as the case of said going-up circuit and the method of getting down and judging the propriety of use of a radio channel based on each CIR of a circuit in case a radio channel is chosen, CIR of an uphill circuit must be set up highly. CIR threshold THru which fulfills this condition is said ** (3). From a formula, it is set to THru=24.4dB and 4.4dB must be set up highly.

[0023] When this condition is applied, the range r2 in which communication link 2 is possible is.

|r2|<=0.06r1+0.06D — It becomes [1']. An arrow head shows this condition in drawing 8 . The probability Pc whose communication link 2 is attained when the communication link 1 at this time exists is set to Pc=0.120, and decreases compared with said going-up circuit and method of getting down and judging the propriety of use of a radio channel based on each CIR of a circuit.
[0024] Thus, since the method of judging the propriety of use of a radio channel only based on CIR of an uphill circuit does not need to measure a received wave in a mobile station PS 2 and does not need to transmit control data between a base station BS 2 and a mobile station PS 2, it does not have a fear of causing the increment in traffic and generating of post-dialing delay in a control channel. However, it may get down and Circuit CIR may become smaller than a threshold. For this reason, in order to have been stated previously and to secure a circuit and the same going-down circuit CIR as the case where get down and each CIR of a circuit is measured, respectively, it is necessary to set up the threshold of the going-up circuit CIR highly. Since the distance during the communication link which uses the same channel will increase when the threshold of the going-up circuit CIR is set up highly, the traffic density of migration communication system which can be held decreases, and decline in frequency use effectiveness is caused.
[0025]
[Problem(s) to be Solved by the Invention] As explained above, when choosing a radio channel using an autonomous distributed dynamic channel allocation method, as an approach of judging the propriety of use of a radio channel, there are a going-up circuit and an approach of getting down and judging based on CIR of both circuits, and the approach of judging only based on CIR of an uphill circuit. However, while the former has the advantage that circuit quality is highly securable, increase of the control data traffic between a base station BS 2 and a mobile station PS 2 is caused, or it has the fault which produces the post-dialing delay of a radio link. On the other hand, although the latter does not produce the increment in traffic or generating of post-dialing delay in a control channel, since it needs to set up a threshold highly, it has the fault of the traffic density of a system which can be held decreasing and causing decline in frequency use effectiveness.
[0026] This invention was made paying attention to the above situations, and the place made into the purpose is to offer the wireless channel selection approach and base station equipment of migration communication system which can moreover secure many traffic density which can be held and can raise frequency use effectiveness, without producing the increment in traffic and generating of post-dialing delay in a control channel, in case a radio channel is assigned.
[0027]
[Means for Solving the Problem] In order to attain the above-mentioned purpose the wireless channel selection approach of this invention The receiving level of the subcarrier which came from the mobile station for [above-mentioned] connection through the radio channel of the arbitration of two or more radio channels when choosing the radio channel for connecting between the base station for connection, and mobile stations, The receiving level of the subcarrier which came from other mobile station and other base stations through the same radio channel as the radio channel of the above-mentioned arbitration, respectively is measured in the base station for [above-mentioned] connection, respectively. It is based on the receiving level of the subcarrier which came from the mobile station for [this / that was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. While asking for the received wave pair interference wave ratio of the going-up circuit which goes to the base station for connection from the mobile station for [above-mentioned] connection It is based on the receiving level of the subcarrier which came from the mobile station for [by which measurement was carried out / above-mentioned / above-mentioned] connection, and the receiving level of the subcarrier which came from the base station besides the above. it faces to the mobile station for [above-mentioned] connection from the base station for [above-mentioned] connection — getting down — the received wave pair interference wave ratio of a circuit — presuming — this — it asked — going up — the received wave pair interference wave ratio of a circuit — and it gets down and the propriety of use of the radio channel of the above-mentioned arbitration is judged based on the

presumed received wave pair interference wave ratio of a circuit.
[0028] On the other hand, in order to attain the above-mentioned purpose, the base station equipment of this invention is equipped with a receiving level measurement means, the 1st and 2nd interference detection means, and a judgment means. And in case the radio channel for connecting between one of two or more of the above-mentioned mobile stations is chosen in a receiving level measurement means The receiving level of the subcarrier which came from the mobile station for [above-mentioned] connection through the radio channel of the arbitration of two or more above-mentioned radio channels, The receiving level of the subcarrier which came from other mobile station and other base station equipments through the same radio channel as the radio channel of the above-mentioned arbitration, respectively is measured, respectively. It is based on the receiving level of the subcarrier which came from the mobile station for [this / that was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. While asking for the received wave pair interference wave ratio of the going-up circuit which faces to the base station equipment of self from the mobile station for [above-mentioned] connection with the interference detection means of the above 1st It is based on the receiving level of the subcarrier which came from the mobile station for [which was measured / above-mentioned] connection,. and the receiving level of the subcarrier which came from base station equipment besides the above. The received wave pair interference wave ratio of the going-down circuit which faces to the mobile station for [above-mentioned] connection from the base station equipment of self with the interference detection means of the above 2nd is presumed. Based on the received wave pair interference wave ratio of this called-for going-up circuit, and the presumed received wave pair interference wave ratio of a going-down circuit, the propriety of use of the radio channel of the above-mentioned arbitration is judged.
[0029] Moreover, the base station equipment of this invention is set for the interference detection means of the above 1st, when the transmission level of two or more base station equipments and the transmission level of two or more mobile stations are set as the same value, respectively. While searching for propagation loss of the transmission line which faces to the base station equipment of self from the mobile station for [above-mentioned] connection from the receiving level of a subcarrier and the transmission level of the above-mentioned mobile station which came from the mobile station for connection Propagation loss of the transmission line which faces to the base station equipment of self from a mobile station besides the above is searched for from the receiving level of a subcarrier and the transmission level of the above-mentioned mobile station which came from other mobile stations. It is characterized also by asking for the received wave pair interference wave ratio of the going-up circuit which faces to the base station equipment of self from the mobile station for [above-mentioned] connection based on the difference of these propagation loss.
[0030] Furthermore, the base station equipment of this invention is set for the 2nd interference detection means, when the transmission level of two or more base station equipments and the transmission level of two or more mobile stations are set as the same value, respectively. While searching for propagation loss of the transmission line which goes to a self base station from the mobile station for [above-mentioned] connection from the receiving level of a subcarrier and the transmission level of the above-mentioned mobile station which came from the mobile station for connection Propagation loss of the transmission line which faces to the base station equipment of self from base station equipment besides the above is searched for from the receiving level of a subcarrier and the transmission level of the above-mentioned base station equipment which came from other base stations. It is characterized also by the thing which face to the mobile station for [above-mentioned] connection from the base station equipment of self based on the difference of these propagation loss and for which it gets down and the received wave pair interference wave ratio of a circuit is presumed.
[0031]
[Function] It is presumed based on the receiving level of the subcarrier which came from the base station equipment of the others for which it gets down and the received wave pair interference wave ratio (CIR) of a circuit is using the same radio channel which faces to the

mobile station for connection from the base station equipment for connection, and goes up with CIR of this presumed going-down circuit, and, as a result, according to the wireless channel selection approach and the base station equipment of this invention, the propriety of use of a radio channel is judged based on CIR of a circuit.

[0032] Therefore, it becomes possible to judge the propriety of use of a radio channel only by measurement of the receiving level in base station equipment, and measurement of the receiving level in the mobile station for connection and the transition of measurement data from this mobile station for connection to base station equipment become unnecessary. For this reason, the increment in traffic and generating of post-dialing delay in a control channel are reduced. Moreover, since it gets down to the judgment of the use propriety of a radio channel not only in the CIR measured value of an uphill circuit and the CIR estimate of a circuit is also used for it, it becomes possible to perform an exact judgment compared with the case where it judges only using the CIR measured value of an uphill circuit. For this reason, it becomes possible to shorten distance during the communication link which it becomes unnecessary to have set up the threshold for a CIR judging highly, and used the same channel by this, and increment in the traffic density of migration communication system which can be held, as a result improvement in frequency use effectiveness can be aimed at.

[0033] Moreover, when the transmission level of two or more base station equipments and the transmission level of two or more mobile stations are set as the same value, respectively, the propagation loss of each transmission line can be searched for easily, and can be gone up only from receiving level by this, and calculation of CIR of a circuit and a going-down circuit, as a result use propriety of a radio channel can be judged easily.

[0034]

[Example] Drawing 1 is the circuit block diagram showing the configuration of the base station of the migration communication system concerning one example of this invention. In this drawing, the radio frequency signal which came from the mobile station which is not illustrated is inputted into a receive section 13 through the high frequency switch (SW) 12 of the wireless section 1, after being received by the antenna 11. In this receive section 13, the radio frequency signal by which reception was carried out [above-mentioned] is mixed with the receiving station section oscillation signal generated from the frequency synthesizer 14, and frequency conversion is carried out to a received intermediate frequency signal. In addition, the local oscillation frequency generated from the above-mentioned frequency synthesizer 14 is directed from a control section 6 according to a radio-channel frequency. Moreover, the received field strength detecting element (RSSI) 16 is formed in the wireless section 1. In this received field strength detecting element 16, the received field strength of the wireless subcarrier which came from a mobile station and other base stations is detected, and that detection value is notified to a control section 6 for the wireless channel selection control mentioned later.

[0035] The received intermediate frequency signal outputted from the above-mentioned receive section 13 is inputted into the recovery section 21 of the modem section 2. In the recovery section 21, the digital recovery of the above-mentioned received intermediate frequency signal is performed, and, thereby, a digital message signal is reproduced. In the TDMA decoding section 31 of the TDMA section 3, according to directions of a control section 6, a digital message signal is decomposed for every time slot of a radio channel, and this decomposed digital message signal is inputted into the message section 4.

[0036] The message section 4 is equipped with the channel codec (CH-CODEC) 41 and the speech codec (SP-CODEC) 42. After error correction decode processing is first performed by the channel codec 41, the digital message signal outputted from the above-mentioned TDMA decoding section 31 is inputted into the speech codec 42, and voice decode processing is carried out. And the message signal reproduced by these decode processings is sent out to the control station for mobile communication which is not illustrated through a wire circuit CL from the circuit interface 5 which has a hybrid circuit.

[0037] On the other hand, the message signal which came from the control station through the wire circuit CL is inputted into the speech codec 42 of the message section 4 through the circuit interface 5. And after voice coding processing is carried out by this speech codec 42, it is

error-correcting-code-ized by the channel codec 41, and is inputted into the TDMA encoding section 32 of the TDMA section 3.

[0038] The TDMA encoding section 32 inserts the coding digital message signal outputted from the above-mentioned channel codec 41 in the time slot assigned to the mobile station of a communications partner, and inputs this coding digital message signal into the modulation section 22. In the modulation section 22, digital modulation of the carrier signal is carried out by the above-mentioned coding digital message signal, and this modulated carrier signal is inputted into the transmitting section 15. By mixing the carrier signal by which the modulation was carried out [above-mentioned] with the sending-station section oscillation signal generated from the frequency synthesizer 14, frequency conversion of the transmitting section 15 is carried out to the radio-channel frequency directed by the control section 6, and it is amplified to further predetermined transmitted power level. And the radio frequency signal outputted from this transmitting section 15 is transmitted towards the mobile station of the communications partner which is not illustrated from an antenna 11 through the high frequency switch 12.

[0039] By the way, a control section 6 is what made the microcomputer the main control section, and, in addition to the usual control functions, such as radio-channel connection control, is equipped with the wireless channel selection control means which applied the autonomous distributed dynamic allocation method.

[0040] In case this wireless channel selection control means chooses a radio channel, it measures the received wave level from the mobile station for connection, the interference wave receiving level from other mobile stations which are using the same radio channel, and the receiving level from other base stations which are using the same radio channel through the received field strength detecting element 16, respectively. And while computing propagation loss of each transmission line from such receiving level measured value and asking for the going-up circuit CIR between a connection partner's mobile stations based on this propagation loss, it gets down and CIR of a circuit is presumed. Furthermore, as compared with a threshold, this judges the propriety of use of the above-mentioned radio channel for the CIR calculation value of these going-up circuit, and the CIR estimate of a going-down circuit, respectively.

[0041] Next, the wireless channel selection control action by the base station constituted as mentioned above is explained. Drawing 2 and drawing 3 R> 3 are flow charts which show the control procedure and the contents of control.

[0042] As shown in drawing 5 , while communicating now using the radio channel with a base station BS 1 and a mobile station PS 1, use of the same radio channel shall be tried between a base station BS 2 and a mobile station PS 2.

[0043] As shown in drawing 2 , the control section 6 of a base station BS 2 makes temporary selection of the above-mentioned radio channel by step 2a, and specifies it as the mobile station PS 2 for connection. And the received wave level of the subcarrier which comes from the mobile station PS 2 for connection is first measured through the received field strength detecting element 16 with step 2b in this condition. Next, the receiving level of the interference wave which comes from other mobile stations PS 1 which are using the same radio channel is measured through the received field strength detecting element 16 by step 2c. The receiving level of the subcarrier which comes from other base stations BS 1 which are furthermore using the same radio channel in step 2d is measured through the received field strength detecting element 16.

[0044] Here, now, temporarily, if the transmitted power level of all the base stations of a system also makes an equal equally transmitted power level of a total displacement office, it can calculate propagation loss easily from the measured value of each above-mentioned receiving level. The control section 6 of a base station BS 2 then, the transmission loss L22 of the going-up circuit which goes to the self base station BS 2 from the mobile station PS 2 for connection in step 2e It asks from the received wave level of the subcarrier which comes from the mobile station PS 2 for [above-mentioned] connection. Moreover, the propagation loss L21 of a before [the self base station BS 2] from other mobile stations PS 1 It asks from the receiving level of the interference wave which comes from the mobile station PS 1 besides the above, and the propagation loss Ld of a before [from the base station BS 1 of further others / the self base

station BS 2] is searched for from the receiving level of the subcarrier which comes from the base station BS 1 besides the above.
[0045] Then, if the propagation loss L22, L21, and Ld is searched for, a control section 6 will ask for the formula which step 2f covers the expenses of first, and computes CIR of a circuit, goes up by step 2g further, and expresses the message conditions of a circuit. That is, the going-up circuit CIR is the ** (1) type described previously, i.e., uphill circuit CIR=L21-L22=10alphalog, {(D+r1) /|r2|}.
It is alike and asks more.
[0046] moreover, ** (3) which described previously the CIR conditions in the going-up circuit for newly communicating between a base station BS 2 and a mobile station PS 2 using the same channel in the condition that the communication link is performed between the base station BS 1 and the mobile station PS 1 a formula — that is, r2<= (D+r1) 10-THru/10 (r2> 0) r2 >=-(D+r1) 10-THru/10 (r2<0) It is expressed.
[0047] A control section 6 presumes next CIR of the going-up circuit which goes to a base station BS 2 from a mobile station PS 2 shortly in step 2h, and asks for the presumed message conditional expression of the above-mentioned going-down circuit in step 2i further. That is, CIR of an uphill circuit is presumed as follows from the transmission loss L22 of an uphill circuit, and the propagation loss Ld of a before [from other base stations BS 1 / the self base station BS 2].
It gets down. Presumed CIR=Ld-L22 of a circuit = 10alphalog (D/|r2|) — (2') again in the condition that the communication link is performed between the base station BS 1 and the mobile station PS 1 It gets down for newly communicating between a base station BS 2 and a mobile station PS 2 using the same channel, and gets down from the conditions of CIR in a circuit. From presumed CIR>=THrd of a circuit, and a ****** (2') type r2<= 10-THrd [D and]/10 (r2> 0) 10-THrd [r2 >=-D and]/10 (r2<0) It is expressed like — (4').
[0048] Next, as shown in drawing 3 , it sets to step 3a, and a control section 6 is ****** (3). It judges whether it judges whether it goes up based on a formula and the circuit fulfills the conditions which can be talked over the telephone, and gets down from it based on a ****** (4') type in step 3b further, and the circuit fulfills the conditions which can be talked over the telephone. And it gets down, and the radio channel which shifted to step 3c and made temporary selection previously here a going-up circuit and when it was judged with satisfying the conditions of both circuits is chosen as a forward type, it is specified as a mobile station PS 2, and wireless channel selection control is ended.
[0049] On the other hand, it judges whether the radio channel which has not been chosen yet in all the radio channels that a control section 6 shifts to step 3d, and a system holds here the above-mentioned going-up circuit and when it is judged with getting down and not filling with either of the circuits the conditions which can be talked over the telephone remains. And same control is performed, after shifting to step 3e, making temporary selection of the radio channel which is not chosen [of a degree] here, specifying it as a mobile station PS 2 and returning to step 2b of appropriate after drawing 2 , when the non-chosen radio channel remains.
[0050] Thus, a judgment of the use propriety of a radio channel does the following effectiveness so. That is, it is, the message conditional expression (4), i.e., said **, of the going-down circuit obtained by [said / to which it gets down and receiving level is actually measured in a mobile station PS 2, the message conditional expression, i.e., the ** (4') type of a circuit,] having been presumed. It is parallel to a formula. For this reason, when some threshold THrd(s) are only changed and it actually measures, it is possible to get down in a near precision and to judge the use propriety of a circuit.
[0051] A concrete numeric value is substituted and it is as follows as compared with the case where got down and CIR of a circuit is actually measured. That is, suppose that the CIR threshold was now set as THru=THrd=20dB temporarily. When done so, it asked for the range r2 where the communication link 2 between a mobile station PS 2 and a base station BS 2 is materialized from the ****** (4') type. |r2|<=0.10D — [5] Said ****** (3) It asked from the formula. |r2|<=0.10r1+0.10D — [1] It is given. Drawing 4 is drawing having shown this condition as an axis of abscissa r1 and an axis of ordinate r2. It is the threshold [2] of the actual going-down

circuit CIR which does not measure a broken line by the approach of this example in this drawing. [5] which is shown and was calculated based on the above-mentioned presumption CIR It becomes a thing near this [2].
[0052] Moreover, the probability Pc that the new communication link 2 can be performed between a base station BS 2 and a mobile station PS 2 using the same radio channel in the condition that the communication link 1 between a base station BS 1 and a mobile station PS 1 exists is set to Pc=0.175, and becomes almost equal to Pc=0.174 at the time of actually measuring.
[0053] It is ** (2) although field Ha who gets down as shown in drawing 4 , and does not fill the threshold of Circuit CIR with this example exists. If the minimum CIR value is calculated using a formula, it will be set to 19.1dB, and it becomes what decreased only by 0.9dB from 20dB which is the minimum CIR value at the time of actually measuring.
[0054] Here, when choosing a radio channel, supposing the same minimum CIR value as the case where got down with the uphill circuit and CIR of a circuit is actually measured is required, a CIR threshold must be more highly set up rather than 20dB. However, threshold THrd which fulfills conditions is set to THrd=20.9dB from a ****** (4') type, and it becomes almost unnecessary to set up threshold THrd highly. r2 at this time |r2|<=0.09D — It becomes [5']. This condition [5'] is shown in drawing 4 .
[0055] Moreover, the probability Pc whose communication link 2 which used the same radio channel in the condition that communication link 1 exists is attained is set to Pc=0.164, and becomes high enough compared with the case (Pc=0.120) where the use propriety of a radio channel is judged using the going-up circuit CIR.
[0056] That is, by the wireless channel selection approach of this example, since it got down and the use propriety of a radio channel is judged using a circuit CIR value, an exact judgment can be performed compared with the case where go up without [which had actually been measured and was presumed based on the CIR value of a circuit, and the subcarrier receiving level from other base stations BS 1] getting down and using Circuit CIR, and it judges only using a circuit CIR value. Therefore, it becomes possible to shorten distance during the communication link which it becomes unnecessary to have set up the threshold for a CIR judging highly, and used the same channel by this, and increment in the traffic density of a system which can be held, as a result improvement in frequency use effectiveness can be aimed at.
[0057] And since it can judge only by the measurement in a base station BS 2, the transition of measurement data to a base station BS 2 becomes unnecessary from measurement of the receiving level in the mobile station PS 2 for connection, or this mobile station PS 2 for connection. For this reason, the increment in traffic and generating of post-dialing delay in a control channel can be reduced.
[0058] In addition, this invention is not limited to the above-mentioned example. although for example, the above-mentioned example explained taking the case of the case where the transmitted power level of each base station and a mobile station applies this invention to a respectively equal system — a base station — or it is applicable also to the system from which transmitted power level differs with a mobile station. In this case, the transmitted power level of a mobile station is told to a base station, propagation loss is searched for from that value and receiving level, and it asks for mobile station receiving level from this propagation loss and the transmission level of other base stations further. And it can get down by comparing this receiving level with the receiving level of other base stations measured in the base station, and a circuit CIR value can be calculated.
[0059] Moreover, the wireless channel selection approach of this invention is effective especially in the system of the TDD (Time Division Duplex) method which gets down with an uphill circuit and uses the same radio frequency by the circuit. However, it is possible to apply also to the system of the FDD (Frequency Division Duplex) method which uses a radio frequency which gets down with an uphill circuit and is different by the circuit by forming the facility for getting down and measuring the signal level of a circuit with which the frequencies not only other than it but the usual receiver differ.
[0060] In addition, also with the class of the circuitry of a base station, the control procedure of

a wireless channel selection control means and the contents of control, and migration communication system, in the range which does not deviate from the summary of this invention, it deforms variously and can carry out.

[0061]

[Effect of the Invention] As explained in full detail above, by the wireless channel selection approach of this invention The receiving level of the subcarrier which came from the mobile station for [above-mentioned] connection through the radio channel of the arbitration of two or more radio channels when choosing the radio channel for connecting between the base station for connection, and mobile stations, The receiving level of the subcarrier which came from other mobile station and other base stations through the same radio channel as the radio channel of the above-mentioned arbitration, respectively is measured in the base station for [above-mentioned] connection, respectively. It is based on the receiving level of the subcarrier which came from the mobile station for [this / that was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. While asking for the received wave pair interference wave ratio of the going-up circuit which goes to the base station for connection from the mobile station for [above-mentioned] connection It is based on the receiving level of the subcarrier which came from the mobile station for [by which measurement was carried out / above-mentioned / above-mentioned] connection, and the receiving level of the subcarrier which came from the base station besides the above. it faces to the mobile station for [above-mentioned] connection from the base station for [above-mentioned] connection — getting down — the received wave pair interference wave ratio of a circuit — presuming — this — it asked — going up — the received wave pair interference wave ratio of a circuit — and he gets down and is trying to judge the propriety of use of the radio channel of the above-mentioned arbitration based on the presumed received wave pair interference wave ratio of a circuit

[0062] Moreover, with the base station equipment of this invention, it has a receiving level measurement means, the 1st and 2nd interference detection means, and a judgment means. And in case the radio channel for connecting between one of two or more of the above-mentioned mobile stations is chosen in a receiving level measurement means The receiving level of the subcarrier which came from the mobile station for [above-mentioned] connection through the radio channel of the arbitration of two or more above-mentioned radio channels, The receiving level of the subcarrier which came from other mobile station and other base station equipments through the same radio channel as the radio channel of the above-mentioned arbitration, respectively is measured, respectively. It is based on the receiving level of the subcarrier which came from the mobile station for [this / that was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. While asking for the received wave pair interference wave ratio of the going-up circuit which faces to the base station equipment of self from the mobile station for [above-mentioned] connection with the interference detection means of the above 1st It is based on the receiving level of the subcarrier which came from the mobile station for [which was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from base station equipment besides the above. The received wave pair interference wave ratio of the going-down circuit which faces to the mobile station for [above-mentioned] connection from the base station equipment of self with the interference detection means of the above 2nd is presumed. He is trying to judge the propriety of use of the radio channel of the above-mentioned arbitration based on the received wave pair interference wave ratio of this called-for going-up circuit, and the presumed received wave pair interference wave ratio of a going-down circuit.

[0063] Therefore, according to the wireless channel selection approach and base station equipment of this invention, in case a radio channel is assigned, the wireless channel selection approach and base station equipment of migration communication system which can moreover secure many traffic density which can be held and can raise frequency use effectiveness can be offered, without producing the increment in traffic and generating of post-dialing delay in a control channel.

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TECHNICAL FIELD

[Industrial Application] Especially this invention relates to the wireless channel selection approach and base station equipment of a system which adopted the autonomous distributed dynamic allocation method as a radio-channel allocation method with respect to migration communication system, such as an analog cordless telephones system, and a digital cordless telephones system, a digital automobile, a cellular-phone system.

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PRIOR ART

[Description of the Prior Art] In the migration communication system which has two or more base station and two or more mobile stations, in order to raise frequency use effectiveness, it estranges beyond the distance from which interference becomes below an allowed value, and the radio channel is repeated and used. There are a fixed channel allocation (FCA:Fixed Channel Asignment) method and a dynamic channel allocation (DCA:Dynamic Channel Assignment) method as radio-channel allocation method used in such migration communication system.
[0003] The FCA method distributes two or more radio channels to each base station fixed beforehand, and in case it communicates between mobile stations, it chooses and assigns a suitable radio channel out of the above-mentioned radio channel by which the base station was distributed to the local station. On the other hand, in case a DCA method communicates between mobile stations, it chooses and assigns each base station for a suitable radio channel out of all the radio channels that a system holds. Since the circuit design is unnecessary as compared with a FCA method, a DCA method has the advantage which can assign a radio channel flexibly according to traffic.
[0004] By the way, to choose a radio channel with this DCA method, while interference needs to choose the radio channel below an allowed value, it is necessary to consider that a communication link in use [other] is not affected. In the base station which has not been estranged beyond a predetermined distance as a wireless channel selection method with which are satisfied of these conditions, there are a method which does not use the same radio channel, and a method which chooses a radio channel after confirming not giving interference to this communication link, when other communication links which used the same radio channel exist.
[0005] It is necessary to communicate a control signal indirectly through direct or a control station, and to acquire the information for choosing a radio channel by these selection methods, among other base stations where the base station which is going to choose a radio channel is using the same radio channel. However, an increment of the number of base stations increases the traffic by this control signal quickly. Since the number of base stations especially increases very much in a microcell system, selection of the radio channel by such method is difficult in practice.
[0006] Then, adoption of the DCA method of autonomous distributed type which does not need to communicate a control signal between base stations is considered as a radio-channel allocation method for a microcell system.
[0007] what chooses a radio channel only using the information from which an autonomous distributed DCA method is obtained in a local station, without each base station communicating between base stations besides each — it is — selection of this radio channel — for example, it is carrying out as follows. In addition, here explains taking the case of the case where the effect of interference is evaluated using the ratio CIR of received wave level and interference wave level (Carrier to Interference Ratio).
[0008] That is, the information which can be used when choosing a radio channel with an autonomous distributed DCA method is restricted to the information acquired with the mobile station which communicates with the information and the self-base station which are obtained in a self-base station. Therefore, the direct valuation of the degradation of CIR given to other

communication links which use the same channel cannot be carried out. For this reason, the method which makes low the probability for CIR of other communication links to deteriorate rather than a necessary value is used by choosing a radio channel with sufficient margin for CIR.
[0009] Drawing 6 is for explaining the wireless channel selection approach by the autonomous distributed DCA method, and while communicating using the radio channel with a base station BS 1 and a mobile station PS 1, it shows the case where it is going to use the same radio channel between a base station BS 2 and a mobile station PS 2. In addition, although the number of communication links which is using the same radio channel here is explained as 1, when the number of communication links is plurality, it is measurable in CIR similarly by adding two or more interference waves.
[0010] First, a going-up circuit and the method of getting down, measuring CIR of both circuits and judging the use propriety of a radio channel are described. The receiving level of the transmission wave of a mobile station PS 2 and the interference wave level from other mobile stations PS 1 which are using the same channel are measured, respectively, it goes up by comparing such level, and a base station BS 2 calculates CIR of a circuit. A mobile station PS 2 measures the receiving level of the transmission wave of a base station BS 2, and the interference wave level from other base stations BS 1 which are using the same channel, respectively, gets down by comparing such level, and calculates CIR of a circuit. And a base station BS 2 uses as an usable channel these going-up circuits CIR and the radio channel with which it gets down and both the circuits CIR fill a threshold.
[0011] It is as follows when the above judgment approach is expressed using a formula. Namely, in drawing 6 , distance between r1, a base station BS 2, and a mobile station PS 2 is set [the distance between base stations BS / BS1 and / 2] to r2 for the distance between D, a base station BS 1, and a mobile station PS 1. Furthermore, propagation loss to the base station BS 2 from L21 and a mobile station PS 2 is set [the propagation loss to a mobile station PS 2] to L22 for the propagation loss to the base station BS 2 from L12 and a mobile station PS 1 from a base station BS 1. When it does so, CIR of the going-up circuit which goes to a base station BS 2 from a mobile station PS 2, and CIR of the going-down circuit which faces to a mobile station PS 2 from a base station BS 2 are expressed with a degree type, respectively.
[0012]
Uphill circuit CIR=L21-L22 = 10alphalog {(D+r1) /|r2|} — (1) It gets down and is circuit CIR=L12-L22. =10alphalog {(D-r2) /|r2|} — (2) However, alpha is a propagation coefficient.
[0013] Here in the condition that the communication link (communication link 1) is performed between the base station BS 1 and the mobile station PS 1 If the threshold of THru [dB] and the going-down circuit CIR is set to THrd [dB], the conditions for communicating between a base station BS 2 and a mobile station PS 2 using the same channel (communication link 2) the threshold of the going-up circuit CIR r2<= (D+r1) 10-THru/10 (r2> 0) r2 >=-(D+r1)10-THru/10 (r2<0) — (3) r2<= D (10THrd / 10 +1)-1 (r2> 0) r2 >=-D(10THrd/10 -1)-1 (r2<0) — (4) It is expressed like.
[0014] Base stations BS 2 are these ** (3) about each radio channel which a system holds, respectively. A formula and ** (4) It judges whether the conditions of a formula are fulfilled to coincidence, and if the radio channel which fulfills conditions is found, this radio channel will be assigned to the communication link between mobile stations PS 2.
[0015] In addition, if the transmitting output level of all the base stations BS1 and BS2 and the transmitting output level of all the mobile stations PS1 and PS2 are assumed to be what is set as the same value, respectively, each above-mentioned propagation loss L22, L21, and L12 can be searched for from the receiving level of the above-mentioned transmission wave, and the receiving level of an interference wave, respectively. In addition, it is possible to calculate CIR, also when transmission levels differ for every base station and every mobile station.
[0016] It is as follows when a concrete numeric value is substituted for the above-mentioned formula. That is, if a CIR threshold is now set to THru=THrd=20dB, the range r2 in which communication link 2 is possible is ****** (3). A formula and ** (4) More respectively than a formula |r2|<=0.10r1+0.10D — [1] -0.11 D<=r2 <=0.09D — [2] It becomes. Drawing 7 is drawing having shown this condition as an axis of abscissa r1 and an axis of ordinate r2.

[0017] If it assumes that it is that from which mobile stations PS1 and PS2 are uniformly distributed over [-0.5 and 0.5], respectively, the probability Pc whose communication link 2 is attained when communication link 1 exists can be expressed with the area of slash I in drawing 7 R> 7, and will be set to Pc=0.174.
[0018] It had been stated above, and since both a circuit and the method of getting down and judging the propriety of use of a radio channel based on CIR of both circuits can always choose certainly the radio channel which fills a threshold, CIR of a vertical circuit is advantageous [the method] when securing circuit quality highly. On the other hand, in order to get down and to evaluate a circuit, it is necessary to measure in a mobile station PS 2 and to transmit the measurement result or an evaluation result to a base station BS 2. For this reason, increase of the control data traffic between a base station BS 2 and a mobile station PS 2 is caused, or there is a fault which produces the post-dialing delay of a radio link.
[0019] Next, how to go up as a simpler approach, to measure only CIR of a circuit, and to judge the propriety of use of a radio channel is described. The receiving level of the transmission wave of a mobile station PS 2 and the interference wave level from other mobile stations PS 1 which are using the same channel are measured, respectively, it goes up by comparing such level, and a base station BS 2 calculates CIR of a circuit. And this going-up circuit CIR uses as an usable channel the radio channel which fills a threshold.
[0020] CIR of the above-mentioned going-up circuit is ** (1) described previously. The conditions for being in the condition that it is expressed with a formula and the communication link (communication link 1) is further performed between the base station BS 1 and the mobile station PS 1, and communicating between a base station BS 2 and a mobile station PS 2 using the same channel (communication link 2) are said ** (3). It is expressed like a formula. A base station BS 2 is ****** (3) about each radio channel which a system holds, respectively. It judges whether the conditions of a formula are fulfilled, and if the radio channel which fulfills conditions is found, this radio channel will be assigned to the communication link between mobile stations PS 2.
[0021] When the approach of judging the propriety of use of a radio channel is used only based on CIR of this going-up circuit, the range r2 in which communication link 2 is possible is said ** [1]. It is given by the formula. Drawing 8 is drawing having shown this condition as an axis of abscissa r1 and an axis of ordinate r2, and shows the threshold of the going-down circuit which is not measured with the broken line. The establishment Pc whose communication link 2 is attained is set to Pc=0.200, had been described previously, and increases from a circuit and the method (Pc=0.174) of getting down and judging the propriety of use of a radio channel based on CIR of both circuits.
[0022] However, field RO to which it gets down as shown in drawing 8 , and CIR of a circuit does not fill a threshold with the approach of judging the propriety of the use of a radio channel only based on CIR of an uphill circuit exists. Here, it is said ** (2). If the minimum value of CIR is calculated using a formula, it will be set to 15.1dB and will decrease by 4.9dB rather than said going-up circuit and method of getting down and judging the propriety of use of a radio channel based on CIR of both circuits. If it is going to secure the minimum value of the same CIR as the case of said going-up circuit and the method of getting down and judging the propriety of use of a radio channel based on each CIR of a circuit in case a radio channel is chosen, CIR of an uphill circuit must be set up highly. CIR threshold THru which fulfills this condition is said ** (3). From a formula, it is set to THru=24.4dB and 4.4dB must be set up highly.
[0023] When this condition is applied, the range r2 in which communication link 2 is possible is. $|r2| <= 0.06r1+0.06D$ — It becomes [1']. An arrow head shows this condition in drawing 8 . The probability Pc whose communication link 2 is attained when the communication link 1 at this time exists is set to Pc=0.120, and decreases compared with said going-up circuit and method of getting down and judging the propriety of use of a radio channel based on each CIR of a circuit.
[0024] Thus, since the method of judging the propriety of use of a radio channel only based on CIR of an uphill circuit does not need to measure a received wave in a mobile station PS 2 and does not need to transmit control data between a base station BS 2 and a mobile station PS 2, it does not have a fear of causing the increment in traffic and generating of post-dialing delay in

a control channel. However, it may get down and Circuit CIR may become smaller than a threshold. For this reason, in order to have been stated previously and to secure a circuit and the same going-down circuit CIR as the case where get down and each CIR of a circuit is measured, respectively, it is necessary to set up the threshold of the going-up circuit CIR highly. Since the distance during the communication link which uses the same channel will increase when the threshold of the going-up circuit CIR is set up highly, the traffic density of migration communication system which can be held decreases, and decline in frequency use effectiveness is caused.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained in full detail above, by the wireless channel selection approach of this invention The receiving level of the subcarrier which came from the mobile station for [above-mentioned] connection through the radio channel of the arbitration of two or more radio channels when choosing the radio channel for connecting between the base station for connection, and mobile stations, The receiving level of the subcarrier which came from other mobile station and other base stations through the same radio channel as the radio channel of the above-mentioned arbitration, respectively is measured in the base station for [above-mentioned] connection, respectively. It is based on the receiving level of the subcarrier which came from the mobile station for [this / that was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. While asking for the received wave pair interference wave ratio of the going-up circuit which goes to the base station for connection from the mobile station for [above-mentioned] connection It is based on the receiving level of the subcarrier which came from the mobile station for [by which measurement was carried out / above-mentioned / above-mentioned] connection, and the receiving level of the subcarrier which came from the base station besides the above. it faces to the mobile station for [above-mentioned] connection from the base station for [above-mentioned] connection — getting down — the received wave pair interference wave ratio of a circuit — presuming — this — it asked — going up — the received wave pair interference wave ratio of a circuit — and he gets down and is trying to judge the propriety of use of the radio channel of the above-mentioned arbitration based on the presumed received wave pair interference wave ratio of a circuit

[0062] Moreover, with the base station equipment of this invention, it has a receiving level measurement means, the 1st and 2nd interference detection means, and a judgment means. And in case the radio channel for connecting between one of two or more of the above-mentioned mobile stations is chosen in a receiving level measurement means The receiving level of the subcarrier which came from the mobile station for [above-mentioned] connection through the radio channel of the arbitration of two or more above-mentioned radio channels, The receiving level of the subcarrier which came from other mobile station and other base station equipments through the same radio channel as the radio channel of the above-mentioned arbitration, respectively is measured, respectively. It is based on the receiving level of the subcarrier which came from the mobile station for [this / that was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. While asking for the received wave pair interference wave ratio of the going-up circuit which faces to the base station equipment of self from the mobile station for [above-mentioned] connection with the interference detection means of the above 1st It is based on the receiving level of the subcarrier which came from the mobile station for [which was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from base station equipment besides the above. The received wave pair interference wave ratio of the going-down circuit which faces to the mobile station for [above-mentioned] connection from the base station equipment of self with the interference detection means of the above 2nd is presumed. He is trying to judge the propriety of use of the radio channel of the above-mentioned arbitration

based on the received wave pair interference wave ratio of this called-for going-up circuit, and the presumed received wave pair interference wave ratio of a going-down circuit.

[0063] Therefore, according to the wireless channel selection approach and base station equipment of this invention, in case a radio channel is assigned, the wireless channel selection approach and base station equipment of migration communication system which can moreover secure many traffic density which can be held and can raise frequency use effectiveness can be offered, without producing the increment in traffic and generating of post-dialing delay in a control channel.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As explained above, when choosing a radio channel using an autonomous distributed dynamic channel allocation method, as an approach of judging the propriety of use of a radio channel, there are a going-up circuit and an approach of getting down and judging based on CIR of both circuits, and the approach of judging only based on CIR of an uphill circuit. However, while the former has the advantage that circuit quality is highly securable, increase of the control data traffic between a base station BS 2 and a mobile station PS 2 is caused, or it has the fault which produces the post-dialing delay of a radio link. On the other hand, although the latter does not produce the increment in traffic or generating of post-dialing delay in a control channel, since it needs to set up a threshold highly, it has the fault of the traffic density of a system which can be held decreasing and causing decline in frequency use effectiveness.
[0026] This invention was made paying attention to the above situations, and the place made into the purpose is to offer the wireless channel selection approach and base station equipment of migration communication system which can moreover secure many traffic density which can be held and can raise frequency use effectiveness, without producing the increment in traffic and generating of post-dialing delay in a control channel, in case a radio channel is assigned.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose the wireless channel selection approach of this invention The receiving level of the subcarrier which came from the mobile station for [above-mentioned] connection through the radio channel of the arbitration of two or more radio channels when choosing the radio channel for connecting between the base station for connection, and mobile stations, The receiving level of the subcarrier which came from other mobile station and other base stations through the same radio channel as the radio channel of the above-mentioned arbitration, respectively is measured in the base station for [above-mentioned] connection, respectively. It is based on the receiving level of the subcarrier which came from the mobile station for [this / that was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. While asking for the received wave pair interference wave ratio of the going-up circuit which goes to the base station for connection from the mobile station for [above-mentioned] connection It is based on the receiving level of the subcarrier which came from the mobile station for [by which measurement was carried out / above-mentioned / above-mentioned] connection, and the receiving level of the subcarrier which came from the base station besides the above. it faces to the mobile station for [above-mentioned] connection from the base station for [above-mentioned] connection — getting down — the received wave pair interference wave ratio of a circuit — presuming — this — it asked — going up — the received wave pair interference wave ratio of a circuit — and it gets down and the propriety of use of the radio channel of the above-mentioned arbitration is judged based on the presumed received wave pair interference wave ratio of a circuit.
[0028] On the other hand, in order to attain the above-mentioned purpose, the base station equipment of this invention is equipped with a receiving level measurement means, the 1st and 2nd interference detection means, and a judgment means. And in case the radio channel for connecting between one of two or more of the above-mentioned mobile stations is chosen in a receiving level measurement means The receiving level of the subcarrier which came from the mobile station for [above-mentioned] connection through the radio channel of the arbitration of two or more above-mentioned radio channels, The receiving level of the subcarrier which came from other mobile station and other base station equipments through the same radio channel as the radio channel of the above-mentioned arbitration, respectively is measured, respectively. It is based on the receiving level of the subcarrier which came from the mobile station for [this / that was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from the mobile station besides the above. While asking for the received wave pair interference wave ratio of the going-up circuit which faces to the base station equipment of self from the mobile station for [above-mentioned] connection with the interference detection means of the above 1st It is based on the receiving level of the subcarrier which came from the mobile station for [which was measured / above-mentioned] connection, and the receiving level of the subcarrier which came from base station equipment besides the above. The received wave pair interference wave ratio of the going-down circuit which faces to the mobile station for [above-mentioned] connection from the base station equipment of self with the interference detection means of the above 2nd is presumed. Based on the received wave pair interference

wave ratio of this called-for going-up circuit, and the presumed received wave pair interference wave ratio of a going-down circuit, the propriety of use of the radio channel of the above-mentioned arbitration is judged.

[0029] Moreover, the base station equipment of this invention is set for the interference detection means of the above 1st, when the transmission level of two or more base station equipments and the transmission level of two or more mobile stations are set as the same value, respectively. While searching for propagation loss of the transmission line which faces to the base station equipment of self from the mobile station for [above-mentioned] connection from the receiving level of a subcarrier and the transmission level of the above-mentioned mobile station which came from the mobile station for connection Propagation loss of the transmission line which faces to the base station equipment of self from a mobile station besides the above is searched for from the receiving level of a subcarrier and the transmission level of the above-mentioned mobile station which came from other mobile stations. It is characterized also by asking for the received wave pair interference wave ratio of the going-up circuit which faces to the base station equipment of self from the mobile station for [above-mentioned] connection based on the difference of these propagation loss.

[0030] Furthermore, the base station equipment of this invention is set for the 2nd interference detection means, when the transmission level of two or more base station equipments and the transmission level of two or more mobile stations are set as the same value, respectively. While searching for propagation loss of the transmission line which goes to a self base station from the mobile station for [above-mentioned] connection from the receiving level of a subcarrier and the transmission level of the above-mentioned mobile station which came from the mobile station for connection Propagation loss of the transmission line which faces to the base station equipment of self from base station equipment besides the above is searched for from the receiving level of a subcarrier and the transmission level of the above-mentioned base station equipment which came from other base stations. It is characterized also by the thing which face to the mobile station for [above-mentioned] connection from the base station equipment of self based on the difference of these propagation loss and for which it gets down and the received wave pair interference wave ratio of a circuit is presumed.

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OPERATION

[Function] It is presumed based on the receiving level of the subcarrier which came from the base station equipment of the others for which it gets down and the received wave pair interference wave ratio (CIR) of a circuit is using the same radio channel which faces to the mobile station for connection from the base station equipment for connection, and goes up with CIR of this presumed going-down circuit, and, as a result, according to the wireless channel selection approach and the base station equipment of this invention, the propriety of use of a radio channel is judged based on CIR of a circuit.
[0032] Therefore, it becomes possible to judge the propriety of use of a radio channel only by measurement of the receiving level in base station equipment, and measurement of the receiving level in the mobile station for connection and the transition of measurement data from this mobile station for connection to base station equipment become unnecessary. For this reason, the increment in traffic and generating of post-dialing delay in a control channel are reduced. Moreover, since it gets down to the judgment of the use propriety of a radio channel not only in the CIR measured value of an uphill circuit and the CIR estimate of a circuit is also used for it, it becomes possible to perform an exact judgment compared with the case where it judges only using the CIR measured value of an uphill circuit. For this reason, it becomes possible to shorten distance during the communication link which it becomes unnecessary to have set up the threshold for a CIR judging highly, and used the same channel by this, and increment in the traffic density of migration communication system which can be held, as a result improvement in frequency use effectiveness can be aimed at.
[0033] Moreover, when the transmission level of two or more base station equipments and the transmission level of two or more mobile stations are set as the same value, respectively, the propagation loss of each transmission line can be searched for easily, and can be gone up only from receiving level by this, and calculation of CIR of a circuit and a going-down circuit, as a result use propriety of a radio channel can be judged easily.

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EXAMPLE

[Example] Drawing 1 is the circuit block diagram showing the configuration of the base station of the migration communication system concerning one example of this invention. In this drawing, the radio frequency signal which came from the mobile station which is not illustrated is inputted into a receive section 13 through the high frequency switch (SW) 12 of the wireless section 1, after being received by the antenna 11. In this receive section 13, the radio frequency signal by which reception was carried out [above-mentioned] is mixed with the receiving station section oscillation signal generated from the frequency synthesizer 14, and frequency conversion is carried out to a received intermediate frequency signal. In addition, the local oscillation frequency generated from the above-mentioned frequency synthesizer 14 is directed from a control section 6 according to a radio-channel frequency. Moreover, the received field strength detecting element (RSSI) 16 is formed in the wireless section 1. In this received field strength detecting element 16, the received field strength of the wireless subcarrier which came from a mobile station and other base stations is detected, and that detection value is notified to a control section 6 for the wireless channel selection control mentioned later.
[0035] The received intermediate frequency signal outputted from the above-mentioned receive section 13 is inputted into the recovery section 21 of the modem section 2. In the recovery section 21, the digital recovery of the above-mentioned received intermediate frequency signal is performed, and, thereby, a digital message signal is reproduced. In the TDMA decoding section 31 of the TDMA section 3, according to directions of a control section 6, a digital message signal is decomposed for every time slot of a radio channel, and this decomposed digital message signal is inputted into the message section 4.
[0036] The message section 4 is equipped with the channel codec (CH-CODEC) 41 and the speech codec (SP-CODEC) 42. After error correction decode processing is first performed by the channel codec 41, the digital message signal outputted from the above-mentioned TDMA decoding section 31 is inputted into the speech codec 42, and voice decode processing is carried out. And the message signal reproduced by these decode processings is sent out to the control station for mobile communication which is not illustrated through a wire circuit CL from the circuit interface 5 which has a hybrid circuit.
[0037] On the other hand, the message signal which came from the control station through the wire circuit CL is inputted into the speech codec 42 of the message section 4 through the circuit interface 5. And after voice coding processing is carried out by this speech codec 42, it is error-correcting-code-ized by the channel codec 41, and is inputted into the TDMA encoding section 32 of the TDMA section 3.
[0038] The TDMA encoding section 32 inserts the coding digital message signal outputted from the above-mentioned channel codec 41 in the time slot assigned to the mobile station of a communications partner, and inputs this coding digital message signal into the modulation section 22. In the modulation section 22, digital modulation of the carrier signal is carried out by the above-mentioned coding digital message signal, and this modulated carrier signal is inputted into the transmitting section 15. By mixing the carrier signal by which the modulation was carried out [above-mentioned] with the sending-station section oscillation signal generated from the frequency synthesizer 14, frequency conversion of the transmitting section 15 is carried out to

the radio-channel frequency directed by the control section 6, and it is amplified to further predetermined transmitted power level. And the radio frequency signal outputted from this transmitting section 15 is transmitted towards the mobile station of the communications partner which is not illustrated from an antenna 11 through the high frequency switch 12.
[0039] By the way, a control section 6 is what made the microcomputer the main control section, and, in addition to the usual control functions, such as radio-channel connection control, is equipped with the wireless channel selection control means which applied the autonomous distributed dynamic allocation method.
[0040] In case this wireless channel selection control means chooses a radio channel, it measures the received wave level from the mobile station for connection, the interference wave receiving level from other mobile stations which are using the same radio channel, and the receiving level from other base stations which are using the same radio channel through the received field strength detecting element 16, respectively. And while computing propagation loss of each transmission line from such receiving level measured value and asking for the going-up circuit CIR between a connection partner's mobile stations based on this propagation loss, it gets down and CIR of a circuit is presumed. Furthermore, as compared with a threshold, this judges the propriety of use of the above-mentioned radio channel for the CIR calculation value of these going-up circuit, and the CIR estimate of a going-down circuit, respectively.
[0041] Next, the wireless channel selection control action by the base station constituted as mentioned above is explained. Drawing 2 and drawing 3 R> 3 are flow charts which show the control procedure and the contents of control.
[0042] As shown in drawing 5 , while communicating now using the radio channel with a base station BS 1 and a mobile station PS 1, use of the same radio channel shall be tried between a base station BS 2 and a mobile station PS 2.
[0043] As shown in drawing 2 , the control section 6 of a base station BS 2 makes temporary selection of the above-mentioned radio channel by step 2a, and specifies it as the mobile station PS 2 for connection. And the received wave level of the subcarrier which comes from the mobile station PS 2 for connection is first measured through the received field strength detecting element 16 with step 2b in this condition. Next, the receiving level of the interference wave which comes from other mobile stations PS 1 which are using the same radio channel is measured through the received field strength detecting element 16 by step 2c. The receiving level of the subcarrier which comes from other base stations BS 1 which are furthermore using the same radio channel in step 2d is measured through the received field strength detecting element 16.
[0044] Here, now, temporarily, if the transmitted power level of all the base stations of a system also makes an equal equally transmitted power level of a total displacement office, it can calculate propagation loss easily from the measured value of each above-mentioned receiving level. The control section 6 of a base station BS 2 then, the transmission loss L22 of the going-up circuit which goes to the self base station BS 2 from the mobile station PS 2 for connection in step 2e It asks from the received wave level of the subcarrier which comes from the mobile station PS 2 for [above-mentioned] connection. Moreover, the propagation loss L21 of a before [the self base station BS 2] from other mobile stations PS 1 It asks from the receiving level of the interference wave which comes from the mobile station PS 1 besides the above, and the propagation loss Ld of a before [from the base station BS 1 of further others / the self base station BS 2] is searched for from the receiving level of the subcarrier which comes from the base station BS 1 besides the above.
[0045] Then, if the propagation loss L22, L21, and Ld is searched for, a control section 6 will ask for the formula which step 2f covers the expenses of first, and computes CIR of a circuit, goes up by step 2g further, and expresses the message conditions of a circuit. That is, the going-up circuit CIR is the ** (1) type described previously, i.e., uphill circuit CIR=L21-L22=10alphalog, {(D+r1) /|r2|}.
It is alike and asks more.
[0046] moreover, ** (3) which described previously the CIR conditions in the going-up circuit for newly communicating between a base station BS 2 and a mobile station PS 2 using the same

channel in the condition that the communication link is performed between the base station BS 1 and the mobile station PS 1 a formula — that is, r2<= (D+r1) 10-THru/10 (r2> 0) r2 >=-(D+r1) 10-THru/10 (r2<0) It is expressed.
[0047] A control section 6 presumes next CIR of the going-up circuit which goes to a base station BS 2 from a mobile station PS 2 shortly in step 2h, and asks for the presumed message conditional expression of the above-mentioned going-down circuit in step 2i further. That is, CIR of an uphill circuit is presumed as follows from the transmission loss L22 of an uphill circuit, and the propagation loss Ld of a before [from other base stations BS 1 / the self base station BS 2].
It gets down. Presumed CIR=Ld-L22 of a circuit = 10alphalog (D/|r2|) — (2') again in the condition that the communication link is performed between the base station BS 1 and the mobile station PS 1 It gets down for newly communicating between a base station BS 2 and a mobile station PS 2 using the same channel, and gets down from the conditions of CIR in a circuit. From presumed CIR>=THrd of a circuit, and a ****** (2') type r2<= 10-THrd [D and]/10 (r2> 0) 10-THrd [r2 >=-D and]/10 (r2<0) It is expressed like — (4').
[0048] Next, as shown in drawing 3 , it sets to step 3a, and a control section 6 is ****** (3). It judges whether it judges whether it goes up based on a formula and the circuit fulfills the conditions which can be talked over the telephone, and gets down from it based on a ****** (4') type in step 3b further, and the circuit fulfills the conditions which can be talked over the telephone. And it gets down, and the radio channel which shifted to step 3c and made temporary selection previously here a going-up circuit and when it was judged with satisfying the conditions of both circuits is chosen as a forward type, it is specified as a mobile station PS 2, and wireless channel selection control is ended.
[0049] On the other hand, it judges whether the radio channel which has not been chosen yet in all the radio channels that a control section 6 shifts to step 3d, and a system holds here the above-mentioned going-up circuit and when it is judged with getting down and not filling with either of the circuits the conditions which can be talked over the telephone remains. And same control is performed, after shifting to step 3e, making temporary selection of the radio channel which is not chosen [of a degree] here, specifying it as a mobile station PS 2 and returning to step 2b of appropriate after drawing 2 , when the non-chosen radio channel remains.
[0050] Thus, a judgment of the use propriety of a radio channel does the following effectiveness so. That is, it is, the message conditional expression (4), i.e., said **, of the going-down circuit obtained by [said / to which it gets down and receiving level is actually measured in a mobile station PS 2, the message conditional expression, i.e., the ** (4') type of a circuit,] having been presumed. It is parallel to a formula. For this reason, when some threshold THrd(s) are only changed and it actually measures, it is possible to get down in a near precision and to judge the use propriety of a circuit.
[0051] A concrete numeric value is substituted and it is as follows as compared with the case where got down and CIR of a circuit is actually measured. That is, suppose that the CIR threshold was now set as THru=THrd=20dB temporarily. When done so, it asked for the range r2 where the communication link 2 between a mobile station PS 2 and a base station BS 2 is materialized from the ****** (4') type. |r2|<=0.10D — [5] Said ****** (3) It asked from the formula. |r2|<=0.10r1+0.10D — [1] It is given. Drawing 4 is drawing having shown this condition as an axis of abscissa r1 and an axis of ordinate r2. It is the threshold [2] of the actual going-down circuit CIR which does not measure a broken line by the approach of this example in this drawing. [5] which is shown and was calculated based on the above-mentioned presumption CIR It becomes a thing near this [2].
[0052] Moreover, the probability Pc that the new communication link 2 can be performed between a base station BS 2 and a mobile station PS 2 using the same radio channel in the condition that the communication link 1 between a base station BS 1 and a mobile station PS 1 exists is set to Pc=0.175, and becomes almost equal to Pc=0.174 at the time of actually measuring.
[0053] It is ** (2) although field Ha who gets down as shown in drawing 4 , and does not fill the threshold of Circuit CIR with this example exists. If the minimum CIR value is calculated using a

formula, it will be set to 19.1dB, and it becomes what decreased only by 0.9dB from 20dB which is the minimum CIR value at the time of actually measuring.
[0054] Here, when choosing a radio channel, supposing the same minimum CIR value as the case where got down with the uphill circuit and CIR of a circuit is actually measured is required, a CIR threshold must be more highly set up rather than 20dB. However, threshold THrd which fulfills conditions is set to THrd=20.9dB from a ****** (4') type, and it becomes almost unnecessary to set up threshold THrd highly. r2 at this time |r2|<=0.09D — It becomes [5']. This condition [5'] is shown in drawing 4 .
[0055] Moreover, the probability Pc whose communication link 2 which used the same radio channel in the condition that communication link 1 exists is attained is set to Pc=0.164, and becomes high enough compared with the case (Pc=0.120) where the use propriety of a radio channel is judged using the going-up circuit CIR.
[0056] That is, by the wireless channel selection approach of this example, since it got down and the use propriety of a radio channel is judged using a circuit CIR value, an exact judgment can be performed compared with the case where go up without [which had actually been measured and was presumed based on the CIR value of a circuit, and the subcarrier receiving level from other base stations BS 1] getting down and using Circuit CIR, and it judges only using a circuit CIR value. Therefore, it becomes possible to shorten distance during the communication link which it becomes unnecessary to have set up the threshold for a CIR judging highly, and used the same channel by this, and increment in the traffic density of a system which can be held, as a result improvement in frequency use effectiveness can be aimed at.
[0057] And since it can judge only by the measurement in a base station BS 2, the transition of measurement data to a base station BS 2 becomes unnecessary from measurement of the receiving level in the mobile station PS 2 for connection, or this mobile station PS 2 for connection. For this reason, the increment in traffic and generating of post-dialing delay in a control channel can be reduced.
[0058] In addition, this invention is not limited to the above-mentioned example. although for example, the above-mentioned example explained taking the case of the case where the transmitted power level of each base station and a mobile station applies this invention to a respectively equal system — a base station — or it is applicable also to the system from which transmitted power level differs with a mobile station. In this case, the transmitted power level of a mobile station is told to a base station, propagation loss is searched for from that value and receiving level, and it asks for mobile station receiving level from this propagation loss and the transmission level of other base stations further. And it can get down by comparing this receiving level with the receiving level of other base stations measured in the base station, and a circuit CIR value can be calculated.
[0059] Moreover, the wireless channel selection approach of this invention is effective especially in the system of the TDD (Time Division Duplex) method which gets down with an uphill circuit and uses the same radio frequency by the circuit. However, it is possible to apply also to the system of the FDD (Frequency Division Duplex) method which uses a radio frequency which gets down with an uphill circuit and is different by the circuit by forming the facility for getting down and measuring the signal level of a circuit with which the frequencies not only other than it but the usual receiver differ.
[0060] In addition, also with the class of the circuitry of a base station, the control procedure of a wireless channel selection control means and the contents of control, and migration communication system, in the range which does not deviate from the summary of this invention, it deforms variously and can carry out.
[0061]

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The circuit block diagram showing the configuration of the base station used with the migration communication system concerning one example of this invention.
[Drawing 2] The flow chart which shows a part for the first portion of the procedure of the wireless channel selection control by the control section of the base station shown in drawing 1 , and the contents.
[Drawing 3] The flow chart which shows the procedure of the wireless channel selection control by the control section of the base station shown in drawing 1 , and the second half part of the contents.
[Drawing 4] Drawing showing the property of the going-up circuit CIR and the circuit measurement in the presumed case of getting down and judging based on Circuit CIR.
[Drawing 5] The explanatory view of the circuit measured for the judgment of the use propriety of the radio channel in one example of this invention.
[Drawing 6] The explanatory view of the circuit measured for the judgment of the use propriety of the radio channel in the former.
[Drawing 7] Drawing showing the property of the going-up circuit CIR in the former, and the circuit measurement in the case of getting down and judging based on Circuit CIR.
[Drawing 8] Drawing showing the property of the circuit measurement in the case of judging based on the going-up circuit CIR in the former.
[Description of Notations]
BS1, BS2 — Base station PS1, PS2 — Mobile station
1 — Wireless section 2 — Modem section
3 — The TDMA section 4 — Message section
5 — Circuit interface 6 — Control section
11 — Antenna 12 — High frequency switch
13 — Receive section 14 — Frequency synthesizer
15 — Transmitting section 16 — Received field strength detecting element (RSSI)
21 — Recovery section 22 — Modulation section
31 — TDMA decoding section 32 — TDMA encoding section
41 — Channel codec (CH-CODEC)
42 — Speech codec (SP-CODEC)
L21, L22, Ld — Propagation loss

[Translation done.]